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WATER RESOURCES STUDY

Metropolitan Spokane Region

SUMMARY REPORT

MAY 1976

METROPOLITAN SPOKANE REGION
MSRWRS
WATER RESOURCES STUDY

LIST OF REPORTS AND APPENDICES

REPORTS

SUMMARY REPORT

Technical Report

APPENDIX	TITLE
A	Surface Water
B	Geology and Groundwater
C	Water Use
D	Wastewater Generation and Treatment
E	Environment and Recreation
F	Demographic and Economic Characteristics
G	Plan Criteria
H (Volume 1)	Plan Formulation and Evaluation
H (Volume 2)	Plan Formulation and Evaluation
I	Institutional Analysis
J	Water Quality Simulation Model

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METROPOLITAN SPOKANE REGION WATER RESOURCES STUDY.

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SUMMARY REP[redacted]T.

DISTRIBUTION STATEMENT A

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The summary report was prepared by the Seattle District, Corps of Engineers. The technical report and appendices were prepared for the Seattle District, Corps of Engineers by Kennedy-Tudor Consulting Engineers.

The Corps of Engineers expresses appreciation to the following individuals and groups for their assistance in conducting the study:

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PREFACE

With the enactment of the Federal Water Pollution Control Act Amendment of 1972 (Public Law 92-500), new national goals have been established for the elimination of pollution discharges into our streams and lakes. This report was prepared to assist local government in satisfying State and Federal requirements relating to Public Law 92-500. The study suggests a regional wastewater management plan for the metropolitan Spokane urban area and provides major input to Washington State Department of Ecology Section 303e plans for the Spokane River Basin in Washington State. Also included in the study are planning suggestions for urban runoff, flood control and protection of the area's water supply resources.

As listed on the inside front cover, documentation for this study consists of a Summary Report prepared by the U.S. Army Corps of Engineers, Seattle District, and a Technical Report with supporting Appendices A through J, prepared for the Corps by Kennedy-Tudor Consulting Engineers.

The consultant's technical report summarizes Appendices A through J which contain 58 individual task section reports prepared during the study.

SYNOPSIS

This study has resulted in a planning report on water resource management for the metropolitan Spokane region. The report culminates an extensive program of data gathering, projection and analysis covering water resources management, making available the necessary facts from which needs were determined and alternative solutions were formulated. The report provides for a twenty-year planning period (1980 to 2000), with emphasis on wastewater management in the metropolitan Spokane area. The report also includes planning recommendations for sludge management, flood damage prevention, urban runoff and protection of area's water supply resources.

The purpose of the study is to provide planning assistance to the local government for satisfying State and Féderal requirements relating to Public Law 92-500. The study has developed several alternative regional wastewater management plans for the metropolitan Spokane urban area. Local interests assisted in screening the range of alternative plans to arrive at selected plans. The study provides major input to Washington State Department of Ecology Section 303e Plan (Basin Planning) for the *Spokane River Basin* in Washington State. Prior to construction of treatment facilities, additional planning as required by Section 201 (Facilities Plans) or Section 208 (Area-Wide Plans) will be necessary. This study will provide much of the data that are needed for the additional planning effort.

The selected wastewater management plan (Plan A) to satisfy the 1983 requirements of PL 92-500 provides for wastewater treatment at the existing Spokane treatment plant (upgraded) for the City of Spokane and North Spokane and a separate treatment facility near Felts Field to serve Spokane Valley. Both facilities will dispose of the effluent to surface waters.

To meet the 1985 interpreted goals of PL 92-500, a future contingency plan to upgrade Plan A (Plan D) provides for the use of land disposal (rapid percolation).

The District Engineer recommends the following:

1. That the report be made available to all Federal, State and local governmental agencies and the regional clearinghouse, which have an interest in control and development of water and related land resources, including wastewater management systems, in the area affected by the study.

2. That the report be provided to those agencies responsible for planning wastewater systems to help meet the requirements of Sections 303e, 208 and 201 of Public Law 92-500 within the study area.

3. That the report be made available to those agencies responsible for other water resource planning as applicable, such as flood control, urban runoff control, and water supply.

4. That this report be transmitted to Congress in partial compliance with the basic study authority.

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ATTACHMENTS

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SECTION I

INTRODUCTION

I. Introduction

Purpose

This report summarizes the findings of the Metropolitan Spokane Region Water Resources Study. It includes a summary and review of wastewater management, flood damage reduction, urban runoff and related water resource problems and needs; study objectives, study coordination, suggested alternative methods of solutions, suggested plans and means of implementing the plans.

Authorization

In response to a request from the Spokane County Board of Commissioners for assistance in meeting Washington State and Federal directives for wastewater management plans, the authorized General Investigations Study, "Spokane River and Tributaries, Idaho and Washington," was expanded in FY 1973 to provide for major emphasis on regional water quality and wastewater management alternatives and related water resource needs for the Spokane County region.

The Spokane River Basin Study was authorized by resolutions of the Senate and House of Representatives Public Works Committees, adopted 7 October 1965 and 5 May 1966, respectively (exhibits 1 and 2), which requested that the Board of Engineers for Rivers and Harbors review the reports of the Chief of Engineers on the Columbia River and Tributaries, published as House Document 403, 87th Congress 2nd Session, and other pertinent reports to determine whether improvements for flood control and other purposes along the Spokane River and its tributaries are advisable at this time.

Study Objectives

The objective of this study is the preparation of a water resource management planning report for a 20-year planning period (1980 to year 2000) and projections to year 2020, with emphasis on wastewater management in the metropolitan Spokane area. This planning report is the culmination of an extensive program of data gathering, projection and analysis covering the full spectrum of water resource management. The goals of water resource management are conservation and protection of

water resources through optimum allocation of use for benefit of man and his environment while providing for the protection or enhancement of the quality of the region's surface and groundwater.

With the enactment of the Federal Water Pollution Control Act Amendment of 1972 (Public Law 92-500), new national goals were established for the elimination of pollution discharges into our streams and lakes. This study provides a planning report to assist local government in satisfying State and Federal requirements relating to Public Law 92-500.

While this water resources management planning study has placed its major emphasis on wastewater management, it also includes planning suggestions for sludge management, flood damage prevention, urban runoff and protection of the area's water supply resources.

The study objectives can be summarized as follows:

1. Development of alternative regional wastewater management plans for the urban area.

2. Development of alternative regional plans for sewage solids disposal.

3. Development of implementation plans for the suggested regional wastewater and sewage solids disposal systems including institutional arrangements and financial plans.

4. Identification and evaluation of the needs for abatement of urban runoff pollution and flooding and possible alternative solutions.

5. Identification and evaluation of the needs for correction of flood control problems and possible alternative corrective measures.

6. Development of planning suggestions for protection of the area's water supply resources.

Study Management

The study was conducted by the Seattle District Corps of Engineers under sponsorship of the Spokane Regional Planning Conference. Technical guidance was provided by the Spokane River Basin Coordinating Committee (SPRIBCO), with guidance from the study's citizens committee (CITCOM). Major cooperating agencies included the City of Spokane, (hereafter called City), Spokane County (hereafter called County), and

the Washington State Department of Ecology (DOE). The study was coordinated with appropriate Federal and State agencies and with the general public within the metropolitan Spokane area. Coordination has also been maintained with Idaho agencies and local interests to assure that the influence of Idaho water on the downstream Washington area is properly addressed in the study.

The Spokane Regional Planning Conference is composed of two representatives from each of the Spokane City Council and Spokane County Board of Commissioners; one representative from each of the Spokane City and Spokane County Planning Commission; one representative of all small cities in Spokane County; and a director with staff.

SPRIBCO consists of the Spokane County Engineer (chairman); Spokane Assistant City Manager for Engineering; Director, Spokane County Planning Commission; Director, Spokane City Planning Commission; one representative each from Pend Oreille, Lincoln, Stevens and Whitman Counties; one representative from the Spokane County Health District; one representative of the Spokane Tribe of Indians; and one Ex Officio member representing the Washington State Department of Ecology.

CITCOM consists of 46 members representing a wide range of interests including League of Women Voters, business, industry, environmental, labor, chamber of commerce, contractors, homeowner associations and the general citizenry.

The study organization is shown graphically in figure 1.

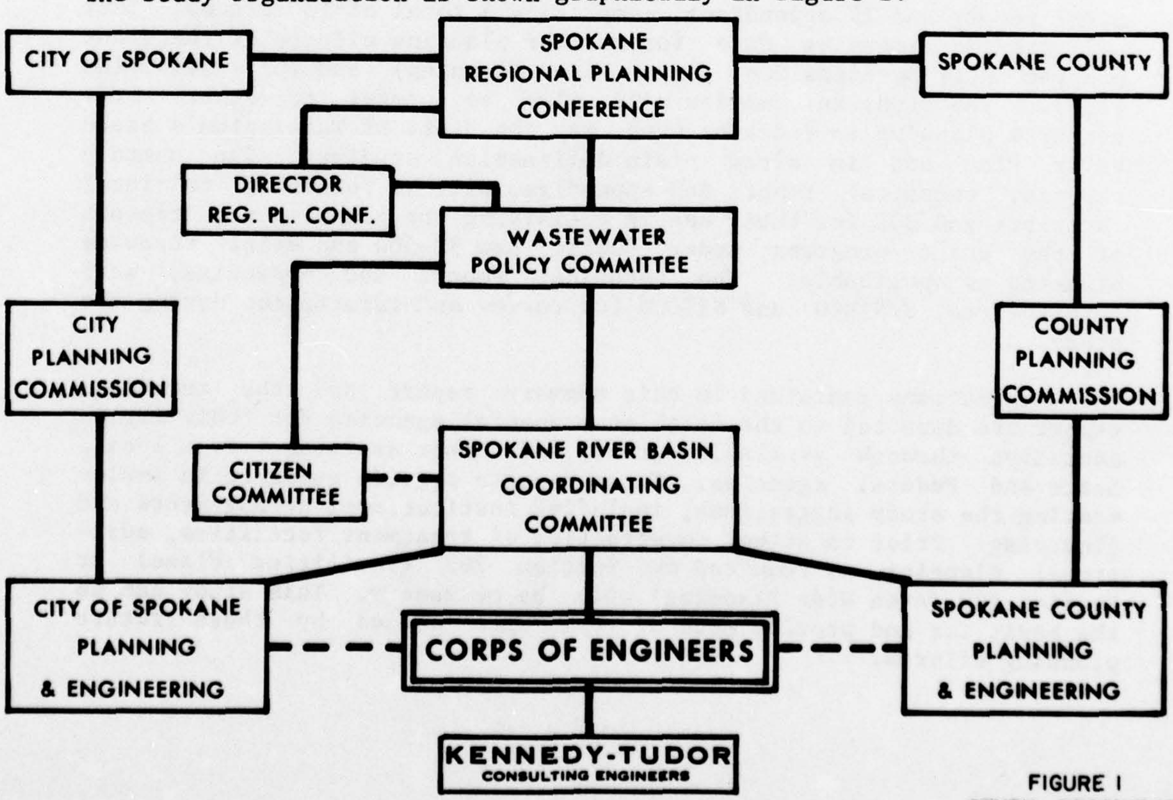


FIGURE I
STUDY ORGANIZATION

A plan of study was prepared to serve as a guide for the coordinated implementation of the study. The plan of study was coordinated with and accepted by SPRIBCO, DOE and Environmental Protection Agency (EPA); and reviewed by other Federal agencies. Contributed services were provided by Spokane County, City of Spokane and DOE.

The Study was initiated in April 1973.

Public Participation

Public involvement in the Metropolitan Spokane Region Water Resources Study was accomplished through the use of public meetings, public workshops, brochures, newsletters, individual contacts, news releases, interagency meetings, SPRIBCO and CITCOM. A detailed discussion of public participation is contained in section VI, Public Involvement and Plan Formulation for Wastewater Management.

Study Output

The study suggests, in part, a regional wastewater management plan for the metropolitan Spokane urban area and provides major input to DOE Section 303e (Basin Planning) plans for the Spokane River basin in Washington State. The study has produced this summary report, a technical report and 11 appendices, comprising a total of 13 volumes. They will provide extensive data for further planning efforts of the grant program under Sections 208 (Area Wide Planning) and 201 (Facilities Plan). The study information will also be useful to other water resource planning in the area such as the State of Washington's State Water Plan and in flood plain delineation studies. The summary reports, technical report and appendixes will be furnished to local interests and DOE for their use in satisfying the planning requirements of the grant programs under Public Law 92-500 and other resource planning as applicable. The technical report and appendixes were furnished to SPRIBCO and SITCOM for review and information during the study.

The suggestions contained in this summary report and the technical report are directed to the local governmental agencies for their implementation through available grant and other assistance from local, State and Federal agencies. These reports provide guidance in implementing the study suggestions, including institutional arrangements and financing. Prior to actual construction of treatment facilities, additional planning as required by Section 201 (Facilities Plans) or Section 208 (Area Wide Planning) will be necessary. This study can be the basis for and provide much of the data needed by these future planning efforts.

SPRIBCO and CITCOM requested that the Corps of Engineers provide a suggested wastewater management plan and also make specific suggestions for the other related water resource aspects of the study. These committees assisted in screening the candidate plans to arrive at the final suggestions.

The Technical Report and Appendices content can be summarized as follows:

1. Technical Report. This volume summarizes the technical appendices and presents the study findings and suggestions for consideration by local interests in meeting the State and Federal requirements for regional wastewater management plans, including sewage solids disposal and respective implementation. It also includes suggestions for flood damage prevention, urban runoff control planning and protection of the area's water supply resources. See exhibit 3 for the technical report contents.

2. Appendices A through J. These appendices contain 58 individual task section reports prepared during the study, including technical data. They provide results of basic data collection and projection; criteria compilation and development; determination of unmet needs; and development, evaluation and selection of alternatives. See exhibit 4 for a detailed listing of the appendices and respective content.

SECTION II

STUDY AREA

II. Study Area

Location

The study area comprises the Washington State portion of the Spokane River Basin with major emphasis centering on the metropolitan Spokane urban and urbanizing area. The Spokane River and its tributaries, shown in figure 2, drain approximately 6640 square miles in eastern Washington and Northern Idaho. The Spokane River begins at the outlet of Coeur d'Alene Lake in Idaho and enters eastern Washington near Spokane. The Washington portion of the basin (study area) shown in figure 3 comprises 34.5 percent or 2295 square miles. The study area includes most of Spokane and Stevens Counties and parts of Pend Oreille, Lincoln and Whitman Counties in Washington.

The principal tributaries of the Spokane River in Washington State are Hangman (Latah) Creek and the Little Spokane River. Principal tributaries of Coeur d'Alene Lake are the St. Joe and Coeur d'Alene Rivers.

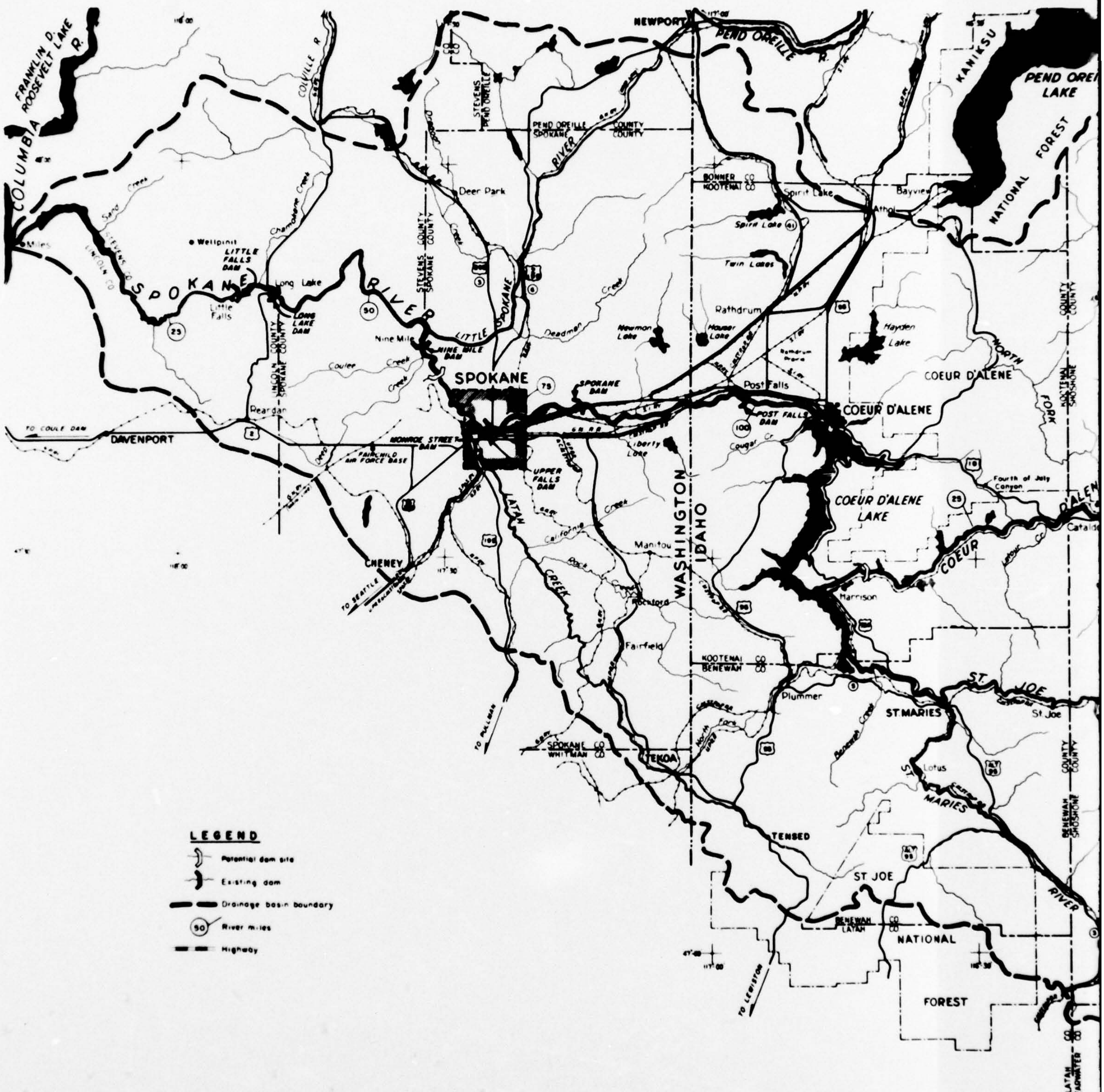
Climate

The Spokane River Basin has a modified maritime climate. Temperature conditions are generally mild with periodic exceptions in both winter and summer months when continental air masses become predominant producing temperature extremes in the range from 110°F to -45°F in Spokane.

Significant factors which influence the climate of the study area are the prevailing westerly winds, location relative to the Pacific Ocean and the Cascade Mountains on the West and Rocky Mountains on the East, the continental influence of adjoining land mass areas and the elevation gradient.

The temperature regimen is quite uniform. Summers are characterized by temperatures ranging between 80 to 90°F daytime and 45 to 60°F at night. Winter temperatures range between 25 to 40°F daytime and 15 to 25°F at night.

Mean annual precipitation ranges from 17 inches at points of lowest elevation to over 45 inches on Mount Spokane. Seasonal precipitation is least during summer, increasing in fall, reaching a peak in winter and decreasing again in spring. Most precipitation between December



FRANKLIN D. ROOSEVELT LAKE
COLUMBIA R.
NEWPORT
PEND OREILLE R.
PEND OREILLE LAKE
KANIKSU
NATIONAL FOREST
COLVILLE R.
STEVENS PEND OREILLE
PEND OREILLE COUNTY
SPOKANE COUNTY
BONNER CO
KOOTENAI CO
Spirit Lake
Bayview
Athol
Deer Park
Wellpinit
LITTLE FALLS DAM
Long Lake
LONG LAKE DAM
Little Falls
SPOKANE RIVER
LITTLE SPOKANE
Twin Lakes
Rathdrum
Hayden Lake
Newman Lake
Nine Mile
NINE MILE DAM
SPOKANE
SPOKANE DAM
Post Falls
POST FALLS DAM
COEUR D'ALENE
NORTH FORK
Reardan
DAVENPORT
TO COULE DAM
MONROE STREET DAM
FAIRCHILD AIR FORCE BASE
UPPER FALLS DAM
Liberty Lake
Cougar Cr.
COEUR D'ALENE LAKE
Fourth of July Canyon
Cataldo
LATAH CREEK
California Creek
Rock Creek
Manitou
WASHINGTON
IDAHO
CHENEY
TO SEATTLE
Rockford
Harrison
COEUR
Fairfield
KOOTENAI CO
BENEWAH CO
Plummer
ST MARIES
ST JOE
St Joe
TO PULMAN
SPOKANE CO
WHITMAN CO
TEKOA
Lotus
ST MARIES
BENEWAH COUNTY
SHOSHONE COUNTY
TENSED
ST JOE
BENEWAH CO
LATAH CO
NATIONAL
FOREST
TO LEWISTON
RIVER
LATAH
CLEARWATER
LEGEND
Potential dam site
Existing dam
Drainage basin boundary
River miles
Highway
SCALE IN MILES

FIGURE 2
SPOKANE RIVER BASIN

2

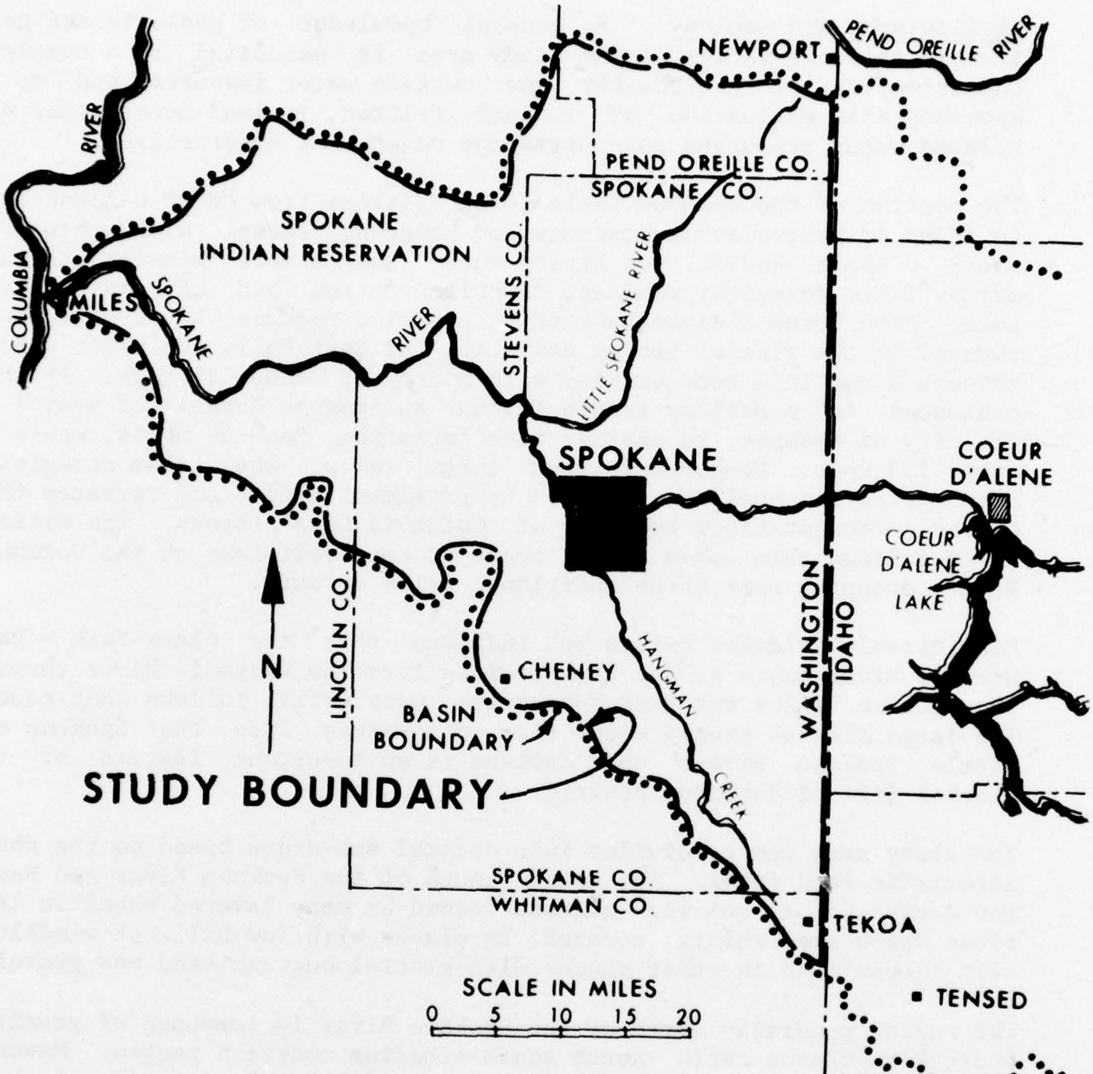


FIGURE 3

METROPOLITAN SPOKANE REGION

and February occurs as snow which averages about 50 inches per year throughout the area, except on Mount Spokane where an average of 170 inches per year falls at the summit.

The growing season varies with altitude and local conditions. Spokane has had a 62-year mean growing season of 183 days.

Physiography and Geology. A general knowledge of geologic and geographic characteristics of the study area is essential to a complete understanding of groundwater and surface water resources and to a knowledgeable evaluation of impacts related to land development and related water resources and wastewater management alternatives.

The portion of the Spokane Basin lying upstream from Coeur d'Alene Lake in Idaho is generally mountainous and rugged, except along the lower Coeur d'Alene and St. Joe Rivers where the rivers meander through marshy flats formed by sediment deposited on the bed of Coeur d'Alene Lake. From Coeur d'Alene Lake to Post Falls, Spokane River occupies a channel in the glacial gravel and silt. At Post Falls the river passes through a gap in a rock barrier with a drop of about 55 feet. It then continues in a shallow trench through an immense deposit of gravel to the City of Spokane, to another rock formation, Spokane Falls, where it drops 133 feet. Downstream from these falls, the stream occupies a deep, gorge-like valley, bordered by prominent cliffs and terraces that extend northwest along the edge of Columbia Lava Plateau. The Spokane River follows this gorge to its mouth at Roosevelt Lake on the Columbia River, dropping over three additional falls enroute.

Considerable evidence exists to indicate that the Clark Fork - Pend Oreille River Basin at one time drained into the Columbia River through the Spokane Valley and that subsurface water still follows that route. The large flow of ground water that discharges into the Spokane and Little Spokane Rivers near Spokane is an important feature of the glacial fill of Rathdrum Prairie.

The study area can be divided into several sub-areas based on the characteristic land forms. The region south of the Spokane River and Hangman Creek is a rolling plateau formed by many layered basaltic lava flows which are thinly covered in places with low hills of windblown silt (loess) and in other places with glacial outwash sand and gravel.

The region generally north of the Spokane River is composed of granitic bedrock highlands with north-south trending mountain ranges. Maximum elevation is in the order of 4500 feet, with local elevation of about 1900 to 2100 feet.

West of Spokane the basin consists generally of high table lands with deeply eroded valleys.

Many natural lakes are located within the study area, formed mostly by glacial lake outwash or till deposits. The lakes are fed by seasonal local runoff and small streams from the highland areas that drain into underlying permeable gravel deposits.

Gravelly glacial outwash comprises the primary aquifer of the study area located in the Spokane Valley. However, the southerly side of the gorge tends to be underlain by slumped parts of the Latah Formation creating areas of limited groundwater resources.

Population

The 1970 study area population was approximately 290,000 and is expected to increase to 451,000 by the year 2020 (see table 1). In 1970 nearly 90 percent of the study area population was located in an urbanizing area centered on the City of Spokane. This trend is expected to continue, with most of the growth anticipated for the North Spokane and Spokane Valley subareas.

TABLE 1

POPULATION PROJECTIONS FOR STUDY AREA
METROPOLITAN SPOKANE REGION WATER RESOURCES STUDY

County	1970	1980	2000	2020
Spokane County[1]				
Urbanizing Area				
City of Spokane[2]	173,990	186,300	198,200	212,400
North Spokane[3]	19,248	26,800	51,800	69,400
Spokane Valley	55,806	69,300	90,600	111,400
West Plains	9,058	9,300	10,400	11,800
Urbanizing Area Total	258,102	291,700	351,000	405,000
Remainder of County	26,834	29,600	35,600	41,100
Spokane County Total	284,936	321,300	386,600	446,100
Lincoln County[1]	413	380	340	330
Pend Oreille County[1]	884	780	680	730
Stevens County[1]	2,646	2,600	2,700	2,820
Whitman County[1]	855	940	980	1,020
TOTAL in Study Area	289,734	326,000	391,300	451,000

[1]Includes only the portion of county in Spokane River basin.
[2]Includes Moran Prairie and Southwest.
[3]Includes Orchard Prairie.

For purpose of comparison, the Idaho portion of the Spokane River basin, located upstream of the study area, had a 1970 population of approximately 55,000.

Economic Development

The City of Spokane is at the hub of the Inland Empire which economically embraces eastern Washington and Oregon and northern Idaho. Within its sphere of influence no city approaches Spokane in size or in economic activity.

Spokane City and County serve an area with rich farmlands, both non-irrigated and irrigated, extensive mineral deposits and thousands of acres of commercial timber. However, the area is not noted for employment in these fields of activity. Emphasis in Spokane County instead is upon the "secondary" type industries, such as trade, transportation, finance and services. Historically, these are areas of employment which tend to experience a relatively stable existence. As a result, variations in business activity within Spokane County have been less pronounced than elsewhere in the State of Washington. These trends are expected to continue relatively unchanged.

SECTION III

WATER RESOURCES OVERVIEW

III. Water Resources Overview

Surface Water

Most of the available surface water within the study boundary originates in the Idaho headwaters of the Spokane River. The Spokane River conveys a very large quantity of water through the study area, 6,068,000 acre feet per year average. The other major surface flows in the basin include the Little Spokane River, 191,000 acre feet per year average and Hangmen Creek, 229,000 acre feet per year average.

The three primary surface waterways of the basin are significantly different in flow characteristics.

The Spokane River, which derives most of its flow from snowmelt in Idaho, is controlled by Lake Coeur d'Alene, resulting in relatively stabilized flow conditions free from the extreme peaks which would result if the lake did not exist.

The Little Spokane River is not typically subjected to expreme flow peaks and is stabilized during low flow periods by significant inflow of groundwater.

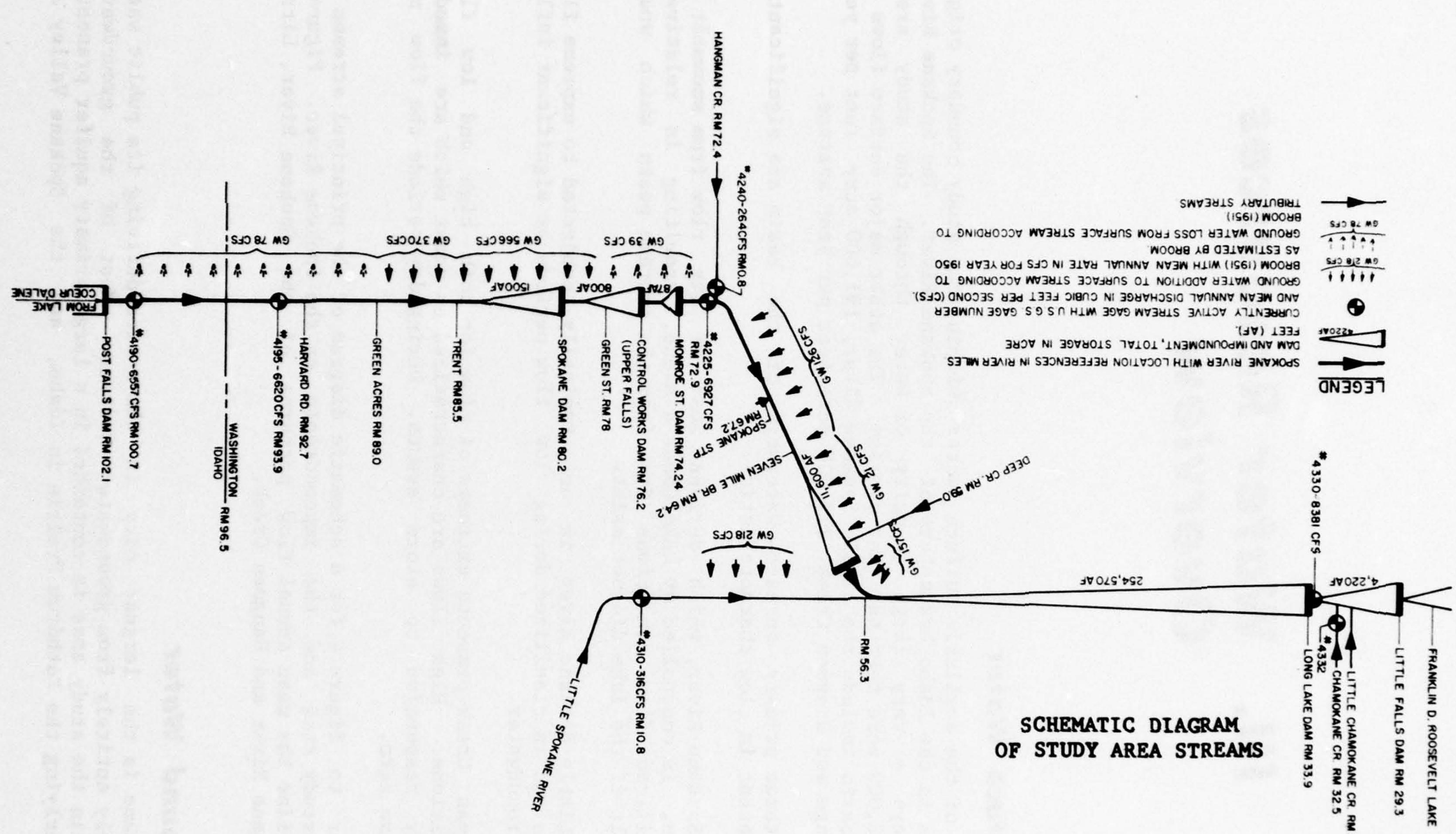
Hangman Creek presents extremes of flow for both high and low flow conditions. High flows are characterized by peaks which are immediately responsive to storm events. During dry periods the flow may become zero.

Refer to figure 4 for a schematic diagram of the principal streams of the study area and the impoundments on the Spokane River. Figure 5 provides the mean annual flow patterns of the Spokane River, Little Spokane River and Hangman Creek.

Ground Water

Spokane is the largest city in the nation deriving its public water supply entirely from groundwater sources. Most of the groundwater within the study area is contained in a large primary aquifer presently underlying the Rathdrum Prairie in Idaho, and the Spokane Valley and

SCHEMATIC DIAGRAM OF STUDY AREA STREAMS



NOTE: Figures for evaporation losses are not included.

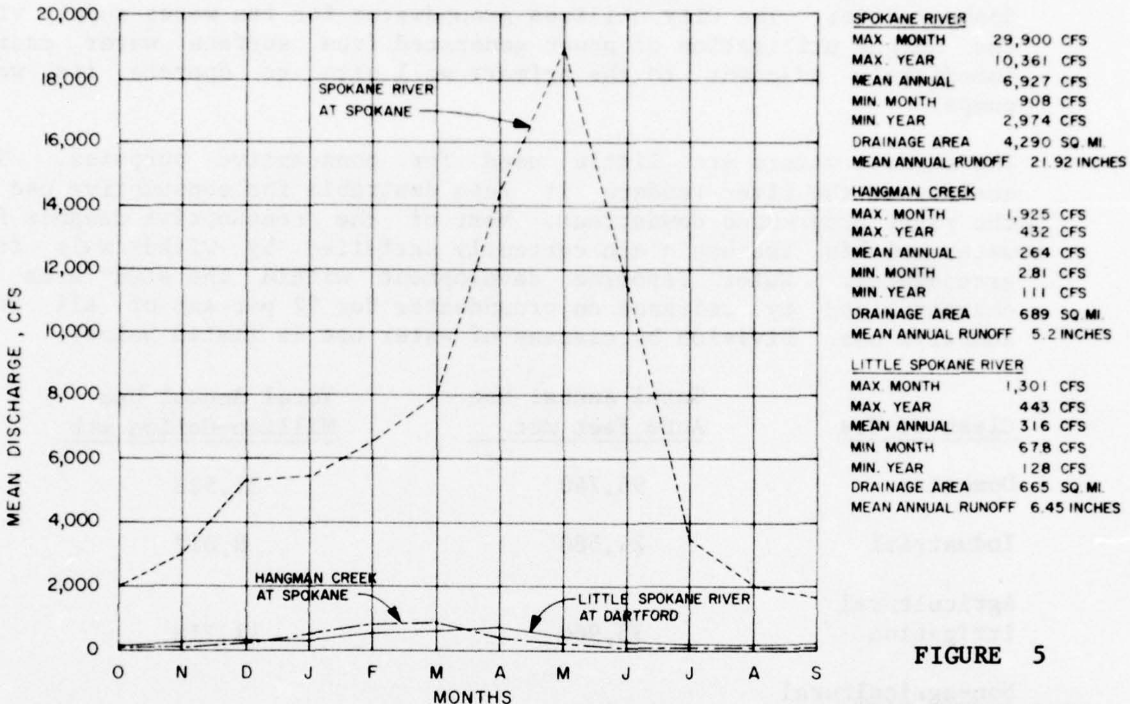


FIGURE 5

MEAN ANNUAL FLOW
PRINCIPAL STUDY AREA STREAMS

the City of Spokane in Washington. The aquifer terminates at the Little Spokane River.

Approximately 1000 cubic feet per second (cfs) of the main aquifer flow originates within Idaho. Additional inflow to the aquifer within the State of Washington is accomplished through the exchange of flow between the aquifer and the Spokane River in the order of 300-400 cfs. Estimates place the total aquifer inflow at 1300 cfs with outflow measurements of 1400 cfs. The difference between inflow and outflow measurements is a reflection of the difficulty of accounting for all flow into and out of the aquifer. This estimated water balance is further complicated by significant consumptive use of this aquifer.

The basalt aquifers have experienced serious water shortages during the summer months. Additional groundwater sources are available in limited alluvial and basalt aquifers within and around the valleys containing Newman and Liberty Lakes, the upper Little Spokane River and the West Plains area.

Existing Water Utilization

At this time the primary utilization of surface waters of the Spokane River Basin is for the purpose of power generation accomplished by a series of hydroelectric structures on the Spokane River. Surface water use for agricultural purposes is limited primarily to the Little Spokane River. The City utilizes groundwater for its water supply with the unique utilization of power generated from surface water energy immediately adjacent to the primary well site to operate its well pumps.

The surface waters are little used for consumptive purposes. The quality of the river renders it less desirable for consumptive use as the river progresses downstream. Most of the consumptive demands for water within the basin are currently satisfied by withdrawals from groundwater. Water resource development within the study area is characterized by reliance on groundwater for 92 percent of all consumptive use. Division by classes of water use is listed below.

Class of Use	Total Annual Use Acre Feet mtt	Total Annual Use Million-Gallon mtt
Domestic	96,740	31,523
Industrial	24,580	8,012
Agricultural irrigation	35,960	11,718
Non-agricultural irrigation	1,600	523
TOTAL	158,880	51,776

The unusually high permeability and close proximity to the surface of the primary Spokane aquifer permits well withdrawals at very high rates of flow with minimal drawdown and power required.

Figure 4 also shows the groundwater interchange with the Spokane and Little Spokane Rivers. Refer to figure 6 for mapping of the aquifer in the study area.

Projected Water Use

The Spokane aquifer flow is approximately 240 billion gallons annually. Water demand forecast for the overall study area indicates that by the year 2020 approximately 86 billion gallons of water will be used annually, nearly a 65 percent increase from the 52 billion gallons used in 1972. This represents withdrawal of 36 percent of the annual flow mainly for non-consumptive purposes. Currently, the urban planning area utilizes 88 percent of the study area's water needs and is fore-

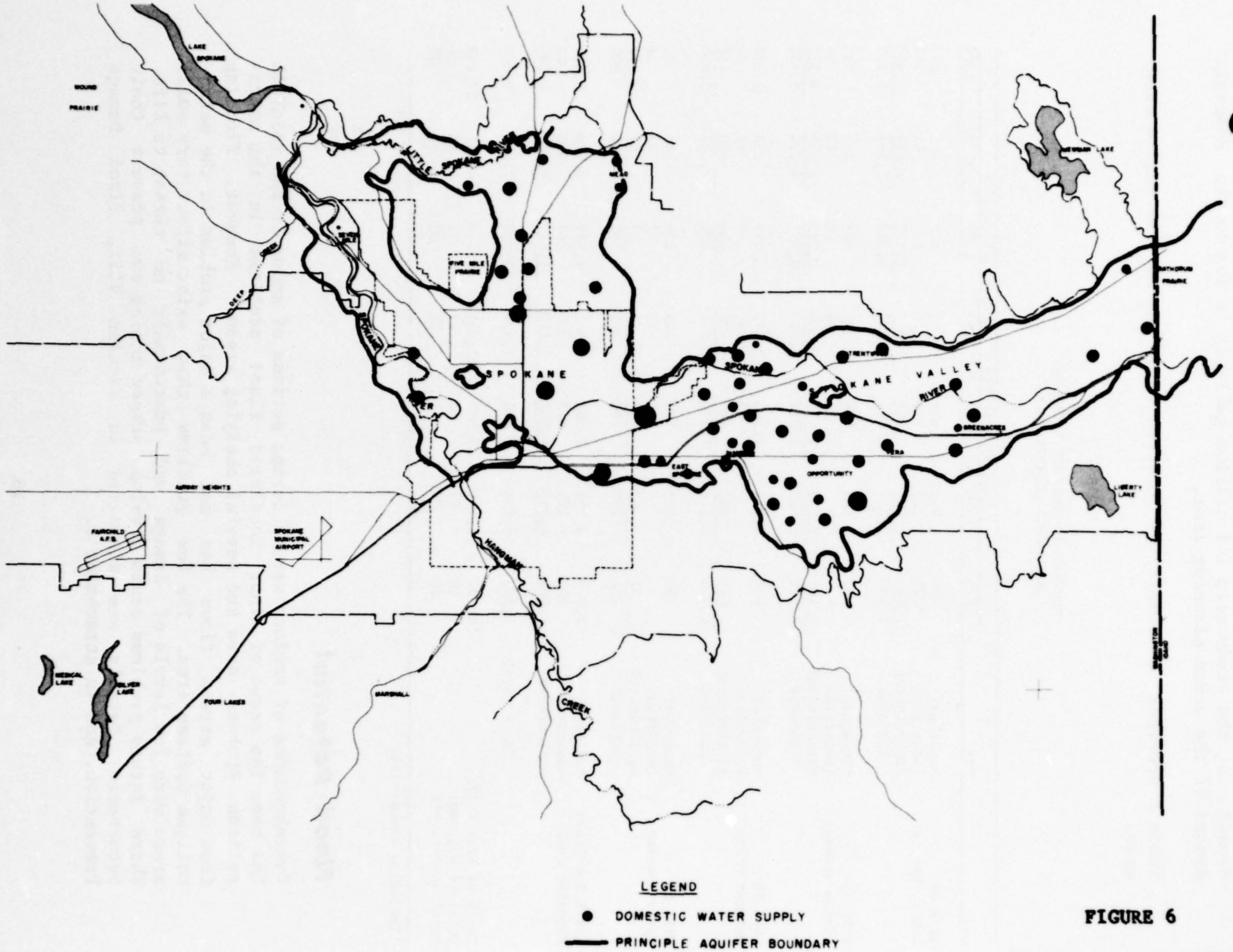


FIGURE 6

SPOKANE VALLEY AQUIFER

cast to utilize 89 percent by the year 2020. Over half of this water demand for the study area (45 billion gallons) is due to the domestic demand of the urban planning area.

Table 2 provides a summary of forecast water use for the entire study area.

TABLE 2

SUMMARY OF FORECAST WATER USE
NON-URBAN PLANNING AREA

		Annual Water Use - Millions of Gallons						
Unit	Use	1970	1980	1985	1990	1995	2000	2020
WRIA 54	Municipal[1]	347	365	376	391	405	416	467
Lower Spokane	Industrial	201	201	234	234	241	241	252
	Agricultural	1,842	1,858	1,865	1,873	1,881	1,889	1,920
	Subtotal	2,390	2,424	2,475	2,498	2,527	2,546	2,639
WRIA 55	Municipal[1]	427	504	537	569	606	642	781
Little Spokane	Industrial	-	-	36	36	40	40	44
	Agricultural	2,115	2,158	2,179	2,200	2,221	2,242	2,327
	Subtotal	2,542	2,662	2,752	2,805	2,867	2,924	3,152
WRIA 56	Municipal[1]	964	1,161	1,263	1,372	1,493	1,635	2,270
Hangman Creek	Industrial			55	58	62	66	80
	Agricultural	480	480	480	480	480	480	480
	Subtotal	1,440	1,641	1,798	1,910	2,035	2,181	2,830
WRIA 57	Municipal[1]	135	172	186	204	226	245	321
Upper Spokane	Industrial			18	18	22	22	26
	Agricultural	57	57	57	57	57	57	57
	Subtotal	192	229	261	279	305	324	404
Total Non-Urban	Municipal[1]	1,873	2,202	2,362	2,536	2,730	2,938	3,839
Planning Area	Industrial	201	201	343	346	365	369	402
	Agricultural	4,494	4,553	4,581	4,610	4,635	4,668	4,784
	Grand Total	6,568	6,956	7,286	7,492	7,730	7,975	9,025
Total as Acre Ft/Yr		20,151	21,341	22,353	22,985	23,728	24,467	27,689
Total as Avg. mgd		18	19	20	21	21	22	25
Total as Avt. cfs		28	30	31	32	33	34	38

[1] Including commercial.

Flood Potential

Overabundance of surface waters during periods of snowmelt and rainfall has been the cause of minor localized flood problems in the metropolitan Spokane area and several outlying areas. However, flooding from major stream flows has not been a major problem in the metropolitan Spokane area. The few problems that exist affect very small areas with low levels of damage and practically no threat to life. Where future problems could develop, proper zoning can prevent their occurrence. Details are discussed in section VIII, Flood Damage Prevention, and in attachment I.

SECTION IV

WASTEWATER OVERVIEW

IV. Wastewater Overview

Wastewater Planning Units

The planning units used for projecting waste loads and formulating alternative wastewater management plans were delineated with consideration for land use, projected development and density patterns, natural topography, existing collection systems and political boundaries.

As illustrated in figure 7, the main study area (urbanizing area) was divided into seven wastewater planning units, two of which were further divided. These units are listed below.

1. The current City of Spokane sewer service area.
2. North Spokane (subdivided in nine areas)
3. Spokane Valley (subdivided to ten areas)
4. Orchard Prairie
5. Moran Prairie
6. South West
7. West Plains

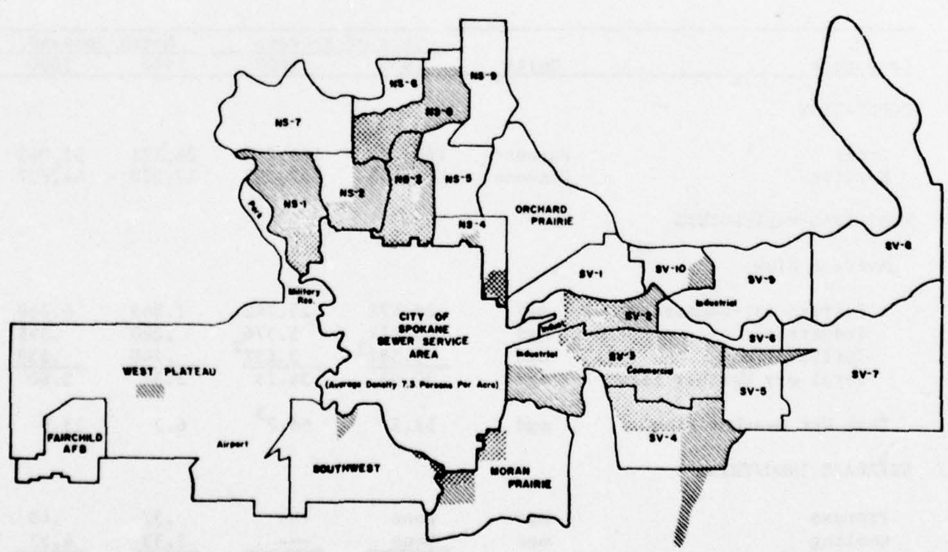


FIGURE 7

URBANIZING AREA

The primary study effort was focused toward the first three planning units as these contain over 85 percent of the population within the Washington portion of the Spokane River Basin.

Existing Wastewater Sources and Systems

The City planning unit is the only area in figure 7 with an extensive wastewater collection system. This system is a combined sanitary-storm system with overflows to the Spokane River. The North Spokane area contains only a limited storm drain system with discharge to the Little Spokane River. The Spokane Valley area contains no developed storm drain system and relies on percolation and dry wells. Neither the North Spokane or the Spokane Valley areas have sanitary sewer systems but rely on individual facilities - usually septic tanks.

Projected Wastewater Flows and Loads

Forecast wastewater flows and loading, not including storm water drainage, are shown on tables 3 and 4.

TABLE 3

POPULATION AND WASTEWATER FLOW FORECAST
CITY OF SPOKANE[1], NORTH SPOKANE AND
SPOKANE VALLEY SERVICE AREAS

Component	Units	City of Spokane 1980	City of Spokane 2000	North Spokane 1980	North Spokane 2000	Spokane Valley 1980	Spokane Valley 2000
POPULATION							
Gross	Persons	186,278	198,210	26,171	51,062	69,300	90,585
Service	Persons	177,945	189,282	17,220	44,627	52,227	74,061
MUNICIPAL WASTEWATERS							
Average Flow							
Residential-Commercial	mgd	22.472	25.242	1.863	4.868	5.456	8.131
Industrial	mgd	3.972	5.376	.280	.388	.808	1.130
Infiltration	mgd	3.582[2]	3.632[2]	.249	.539	.761	.769
Total Dry Weather Flow	mgd	30.03	34.25	2.39	5.80	7.03	10.03
Peak Wet Weather Flow	mgd	52.5[3]	58.7[3]	6.3	13.9	16.6	22.7
SEPARATE INDUSTRIAL							
Process	mgd	None	---	.37	.48	9.99	11.43
Cooling	mgd	None	---	3.33	4.33	18.55	21.22
Total	mgd	None	---	3.70	4.81	28.54	32.65

[1] Includes Moran Prairie and Southwest assuming sewer separation
[2] Assumes identified infiltration.
[3] Excludes storm sewer flow.

TABLE 4

FORECAST POLLUTANT LOADS
RAW MUNICIPAL WASTEWATERS
IN URBAN PLANNING AREA

Component	Units	BOD		Suspended Solids		Total N		Total P	
		1980	2000	1980	2000	1980	2000	1980	2000
CITY									
Residential-Commercial	Pounds/day	33,810	39,749	33,810	39,749	5,516	6,625	1,779	2,271
Industrial	"	11,559	10,092	8,258	6,735	943	1,009	323	337
Subtotal	"	45,369	49,841	42,068	46,484	6,459	7,634	2,102	2,608
Concentration in ADWF	mg/l	181	175	168	163	25.8	26.8	8.4	9.1
NORTH SPOKANE									
Residential-Commercial	Pounds/day	3,272	9,372	3,272	9,372	534	1,562	172	536
Industrial	"	525	727	350	485	52	73	17	24
Subtotal	"	3,797	10,099	3,622	9,857	586	1,635	189	560
Concentration in ADWF	mg/l	191	209	182	204	29.4	33.9	9.5	11.6
SPOKANE VALLEY									
Residential-Commercial	Pounds/day	9,923	15,553	9,923	15,533	1,619	2,592	522	889
Industrial	"	1,514	2,119	1,010	1,413	151	212	50	71
Subtotal	"	11,437	17,672	10,933	16,946	1,770	2,804	572	960
Concentration in ADWF	mg/l	195	212	187	203	30.2	33.6	9.8	11.5
TOTAL URBAN AREA	Pounds/day	60,603	77,612	56,623	73,287	8,815	12,073	2,863	4,128

SECTION V

WATER QUALITY

V. Water Quality

Existing and Projected Surface Water Quality

The quality of the Spokane River as it enters the study area from Idaho is a product of the quality of the Coeur d'Alene and St. Joe Rivers and their combined passage through Coeur d'Alene Lake. The two most significant quality changes to the incoming waters are pickup of zinc from mine tailings on the Coeur d'Alene River and the summer temperature increase due to passage through Coeur d'Alene Lake. Also, the Spokane River does not meet coliform standards for most of the year. In general, Spokane River water is of high quality and meets drinking water standards for all parameters except coliform count and occasionally temperature. There are four tributary sources to the Spokane River after it enters the study area which have a significant impact on quality in addition to the inherent in-stream physical, chemical and biological processes. They are described in the following paragraphs.

1. From State line (RM 96.5) to Hangman Creek confluence (RM 72.9), groundwater estimated at 500 to 600 cfs enters the Spokane River, and differs in quality from the surface flow as follows:

- Relatively constant temperature at approximately 10°C.
- Higher nitrates at 1.6 mg/l.
- Lower zinc at 26 ug/l.

In addition, discharges of cooling water and industrial wastes, along with intermittent overflows from the City combined sewer system, enter the Spokane River within the City of Spokane.

2. Hangman Creek (RM 72.9) is small compared to the Spokane River. However, the heavy silt load carried by Hangman Creek at flood stage is larger than that carried by the Spokane River. Other differences include:

- Higher ammonia throughout the year, ranging from 0.104 to 0.642 mg/l.
- Higher total nitrogen at 1.38 to 2.61 mg/l.
- Higher phosphorus at 0.085 to 0.395 mg/l.

3. The existing primary treated sewage effluent from City sewage treatment plant (STP) at RM 67.2 has the largest quality impact on the Spokane River. Except during the higher river flow season of April through June ammonia, total nitrogen, phosphorus and BOD show large increases below the City STP. Zinc shows a small increase.

4. Little Spokane River confluence at River Mile 56.3 has relatively low phosphorus, ammonia and zinc but high total nitrogen. Coliform counts are also surprisingly high. The Spokane River is actually a lake at the confluence of the Little Spokane River and most data taken downstream from the confluence follow many miles of lake condition and reflect in-stream changes due to lake activity as well as the result of mixing with the Little Spokane River. For all seasons except winter (January through March), the lake retention results in a significant increase in temperature as represented by the surface layer. The high phosphorus levels entering Long Lake are a major factor contributing to the eutrophication problem in summer and fall.

Within Long Lake, the most serious quality deficiency which develops as a consequence of thermal stratification and high nutrient levels is the reduction in dissolved oxygen below the surface layers caused by the demand of dying organisms settling to the bottom.

The primary quality deficiency at the State line is bacteriological. The other parameter of note is zinc. Although zinc concentration is well below drinking water standards, it is significantly higher than most natural waters. It is probable that the coliform count will be improved in the future by enforcement of effluent standards in Idaho, primarily for Coeur d'Alene Lake. It is unlikely that a major change will be achieved in zinc concentrations which have their origin in leachings from mine tailings on the Coeur d'Alene River.

The existing quality of the Spokane River as it enters the study area from Idaho is designated as a baseline condition for projection of future water quality in the study area. Baseline conditions on the Spokane River downstream from the State line were determined, based on the water quality simulation model in a run with all existing point source pollutant loads removed. Projected conditions for surface water discharge of forecast year 2000 municipal flows treated to 1983 standards is the subject of another quality model simulation. The results of both are discussed later in this section under "Simulation Modeling."

Existing and Projected Groundwater Quality

Groundwater quality within the study area is summarized in table 5. Projected changes in groundwater quality are expected to be small and reflect basin activities - barring any catastrophic happenings such as industrial spills over the aquifer. Expected changes include slight increases in salts including nitrates and total solids until on-site disposal systems are replaced by collection and treatment facilities. The groundwater quality is expected to continue to satisfy current U.S. Public Health Service drinking water standards. However, the requirements of the Safe Drinking Water Act (Public Law 93-523), yet to be established, may not be met.

Water Quality Standards

The study area includes Class AA, Class A and Lake Class waters as established by Washington State Department of Ecology. The water quality characteristics for these three classes are described below.

1. Class AA (Extraordinary).

   Total Coliform Organisms shall not exceed median value of 50 with less than 10% of samples exceeding 230 when associated with any fecal source.

   Dissolved Oxygen shall exceed 9.5 mg/l.

   Total Dissolved Gas - The concentration of total dissolved gas shall not exceed 100% of saturation at any point of sample collection.

   Temperature - Water temperatures shall not exceed 60°F (FRESH WATER) due in part to measurable (0.5°F) increases resulting from human activities; nor shall such temperature increases, at any time, exceed $t = 75/(T-22)$; for purposes hereof "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

   pH shall be within the range of 6.5 to 8.5 with an induced variation of less than 0.1 units.

   Turbidity shall not exceed 5 JTU over natural conditions.

TABLE 5

SUMMARY OF GROUNDWATER QUALITY IN THE STUDY AREA

Parameter	Units	Primary Aquifer			Basalt Aquifer			Little Spokane Basin Aquif			Other Aquifers		
		Average	Std.Dev.	Samples	Average	Std.Dev.	Samples	Average	Std.Dev.	Samples	Average	Std.Dev.	Samples
Conductivity	umhos(cm)	283	56	213	263	90	95	292	106	16	285	145	19
Residue (180°C)	mg/l	176	54	61	177	34	64	-	-	-	-	-	-
Residue	TON/AFT	.24	.07	60	.24	.05	64	-	-	-	-	-	-
pH		7.7	.6	210	7.7	.3	95	7.7	.4	16	7.4	.4	19
Temperature	°C	10.7	1.7	81	14	3.3	56	-	-	-	-	-	-
DO	mg/l	8.1	1.1	8	-	-	-	-	-	-	-	-	-
Hardness ($CaCO_3$)	mg/l	156	39	214	108	38	97	151	64	16	136	72	19
NH_3-N	mg/l	.023	.018	61	-	-	-	-	-	-	-	-	-
NO_2-N	mg/l	.002	.002	61	-	-	-	-	-	-	-	-	-
NO_3-N	mg/l	1.506	1.161	62	1.686	2.884	96	1.418	1.624	16	1.046	1.504	19
Kjeldahl Nitrogen (N)	mg/l	<.144	.147	61	-	-	-	-	-	-	-	-	-
PO_4-P (Total)	mg/l	.018	.016	62	.088	.121	31	.095	.082	16	.115	.272	19
PO_4-P (Ortho)	mg/l	.014	.016	61	.070	.099	2	-	-	-	-	-	-
Cl	mg/l	4.6	3.6	210	5.1	7.0	96	3.4	4.5	16	8.6	10.3	19
Al	ug/l	-	-	-	-	-	-	-	-	-	-	-	-
As	ug/l	5	9	61	-	-	-	-	-	-	-	-	-
Cd	ug/l	< 1	2	61	-	-	-	-	-	-	-	-	-
Cr	ug/l	< 1	2	61	-	-	-	-	-	-	-	-	-
Cu	ug/l	< 15	49	61	-	-	-	-	-	-	-	-	-
Fe (Diss)	ug/l	24	29	61	-	-	-	-	-	-	-	-	-
Fe (Total)	ug/l	169	356	146	140*	178	88	100*	100	16	161	167	19
Pb (Diss)	ug/l	< 4	6	55	-	-	-	-	-	-	-	-	-
Pb (Total)	ug/l	19	8	20	-	-	-	-	-	-	-	-	-
Mn	ug/l	7	10	213	-	-	-	-	-	-	-	-	-
Hg (Total)	ug/l	1	4	73	-	-	-	-	-	-	-	-	-
Zn	ug/l	34	73	62	-	-	-	-	-	-	-	-	-
MBAS	mg/l	.03	.03	57	< .06	.01	3	< .05	0	3	-	-	-
Oil & Grease	mg/l	5.7	.6	4	-	-	-	-	-	-	-	-	-
Total Coliform	#/100 ml	< 2	1	9	< 1	0	3	< 1	1	3	-	-	-
Fecal Coliform	#/100 ml	< 1	0	9	< 1	0	3	< 1	0	3	-	-	-

*Data do not permit definition as to whether dissolved or total.

Toxic, Radioactive or Deleterious Material Concentrations shall be less than those which may affect public health, the natural aquatic environment or the desirability of the water for any usage.

Aesthetic Values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch or taste.

Streams which feed natural lakes are designated Class AA. These would include West Branch of the Little Spokane River above Lake Elioka and the Little Spokane above Chain Lake, Blanchard Creek, Brickett Creek, Fish Creek and Thompson Creek.

2. Class A (Excellent).

Total Coliform Organisms shall not exceed median value of 240 with less than 20% of samples exceeding 1000 when associated with any fecal sources.

Dissolved Oxygen shall exceed 8.0 mg/l.

Total Dissolved Gas - The concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

Temperature - Water temperature shall not exceed 65°F due in part to measurable (0.5°F) increases resulting from human activities; nor shall such temperature increases, at any time, exceed $t = 90/(T-19)$; for purposes hereof "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

pH shall be within the range of 6.5 to 8.5 with an induced variation of less than 0.25 units.

Turbidity shall not exceed 5 JTU over natural conditions.

Toxic, Radioactive or Deleterious Material Concentrations shall be below those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use.

Aesthetic Values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch or taste.

By specific designation, the Spokane River from mouth to Idaho Border (RM 91) is Class A, with the following condition.

Special Condition - Temperature - Water temperatures shall not exceed 68°F due in part to measurable (0.5°F) increases resulting from human activities; nor shall such temperature increases, at any time, exceed $t=110/(T-15)$; for purposes hereof, "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

All other impoundments on the Spokane River have mean detention times of much less than 15 days and are therefore classified the same as the river. All other streams not listed under Class AA, in the study area, are designated Class A.

3. Lake Class

Total Coliform Organisms shall not exceed median values of 240 with less than 20% of samples exceeding 1,000 when associated with any fecal source.

Dissolved Oxygen - No measurable decrease from natural conditions.

Total Dissolved Gas - The concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

Temperature - No measurable change from natural conditions.

pH - No measurable change from natural conditions.

Turbidity shall not exceed 5 JTU over natural conditions.

Toxic, Radioactive or Deleterious Material Concentrations shall be less than those which may affect public health, the natural aquatic environment or the desirability of the water for any usage.

Aesthetic Values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch or taste.

Long Lake with storage volume of 254,570 acre feet has been computed by Soltero (1973) to have a mean exchange rate of approximately 30 days, which would place the impoundment in Lake Class based on the definition that all impoundments with mean detention over 15 days are Lake Class. All natural lakes are Lake Class. These include but are not limited to Newman Lake, Liberty Lake, Elioka, Horseshoe, Diamond, Chair, Medical, West Medical, Silver and Clear Lake.

Wastewater Disposal Goals

To 1983. For this study it was assumed that the earliest possible on-line implementation of any major plan for wastewater management resulting from this study would be 1980. Therefore, any facility put into service at that date must anticipate the 1983 milestone requirements of Public Law 92-500 which specify "best practicable waste treatment technology" (BPWTT) by publicly owned treatment facilities. Specification of BPWTT as a disposal requirement is control through effluent standards rather than on the basis of the assimilative capacity of the receiving waters. The law, however, also provides that certain receiving waters may be classified by the respective states as water quality determinative if degradation would result from discharges meeting effluent standards In such cases, Public Law 92-500 provides that more stringent effluent requirements may be determined by the State. The three major streams of the study area (Spokane River, Little Spokane River and Hangman Creek) have received the more stringent classification by the State, i.e., water quality determinative.

Beyond 1983. Future disposal requirements are defined as those beyond the specified 1983 requirements which could evolve from the stated 1985 goal in Public Law 92-500 for "no discharge of pollutants." In a manner similar to that used by EPA to define BPWTT, an interpretation of 1985 goals in made for this study in terms of acceptable alternative treatment processes rather than in terms of numerical quality criteria. The summary results follow.

1. For disposal to surface waters, secondary treatment with nutrient removal followed by the equivalent of carbon absorption and sand (or mixed media) filtration, reoxygenation and disinfection with ozone (to avoid the toxicity problems associated with chlorine disinfection).

2. For disposal on land.

- Irrigation with secondary effluent monitored to prevent nutrient application at rates in excess of plant uptake.

- Overland flow of secondary effluent at monitored rates to prevent nutrient carryover, with the collected overland flow effluent given the equivalent of sand filtration, reoxygenation and disinfection with ozone before release to surface waters.

- Infiltration-percolation of secondary treated effluent with nitrogen removal.

TABLE 6

SIMULATED WATER QUALITY

Meteorological Event				Reach 730 Spokane River Abv. Hangman Cr. Confluence		Reach 430 Spokane River Abv. Little Spk. Confluence		Long Lake-Reach 440						Reach 450 Leaving Long Lake	
								Top Layer		Middle Layer		Bottom Layer			
Date	Time	Parameter	Units	NPS[1]	YR 2000[2]	NPS	YR 2000	NPS	Yr 2000	NPS	YR 2000	NPS	YR 2000	NPS	YR 2000
10Aug68	1800[3]	Dissolved Oxygen	mg/l	8.8	9.9	8.2	9.1	8.1	8.8	6.9	1.8	2.8	0.0	8.2	8.5
		BOD	mg/l	0.6	2.1	1.1	9.1	0.1	1.7	0.0	0.6	0.1	0.4	0.3	2.0
		Temperature	°C	18.5	18.6	20.9	20.8	20.9	20.9	15.0	15.2	10.2	10.3	22.0	22.0
		Total Coliform	org/100 ml	299	297	257	256	42	43	0.0	0.0	0.0	0.0	35	36
		Fecal Coliform	org/100 ml	6	11	5	9	1	1	0.0	0.0	0.0	0.0	1	1
		Orthophosphate	mg/l	.001	.015	0.0	.006	0.0	.001	.031	.064	.082	.133	.001	.001
		Pot. Phosphate	mg/l	.009	.026	.008	.069	0.0	.013	0.0	.005	.001	.003	.002	.015
		Total Phosphate	mg/l	.010	.041	.008	.075	0.0	.014	.031	.069	.083	.136	.003	.016
		Ammonia	mg/l	.006	.123	.013	.048	0.0	.005	0.0	.011	.005	.228	.004	.008
		Total Nitrogen	mg/l	.554	.825	.65	2.69	.44	.98	.33	.59	.50	.62	.46	.99
		Chlorophyll A	ug/l			3.5	48.5	.30	11.3	.10	4.2	.10	.60	.90	12.2
		Flow	cfs	919	957	1065	1106							1107	1107
25Aug68	1800[4]	Dissolved Oxygen	mg/l	9.5	10.1	8.9	9.7	8.5	9.2	6.8	.3	2.0	0.0	8.5	9.1
		BOD	mg/l	1.0	1.6	1.4	5.9	0.1	1.7	0.0	.6	.1	1.7	.2	1.8
		Temperature	°C	17.0	17.1	18.3	18.3	18.4	18.4	15.0	15.2	10.2	10.3	18.9	18.9
		Total Coliform	org/100 ml	468	467	412	412	87	87	0.0	0.0	0.0	0.0	77	77
		Fecal Coliform	org/100 ml	8	13	13	17	4	5	0.0	0.0	0.0	0.0	4	5
		Orthophosphate	mg/l	.003	.016	.001	.005	0.0	.001	.032	.076	.088	.198	.001	.001
		Pot. Phosphate	mg/l	.017	.023	.010	.045	.001	.013	0.0	.005	.001	.013	.001	.014
		Total Phosphate	mg/l	.020	.039	.011	.050	.001	.014	.032	.018	.089	.211	.002	.015
		Ammonia	mg/l	.010	.093	.012	.305	0.0	.013	0.0	.082	.007	.434	.003	.012
		Total Nitrogen	mg/l	.383	.566	.40	1.15	.41	.92	.32	.74	.53	.65	.42	.95
		Chlorophyll A	ug/l			4.6	29.5	.50	11.2	.10	4.1	.10	.60	.50	11.5
		Flow	cfs	1599	1638	1760	1801							1846	2109

[1] NPS = no-point-source simulation.
[2] Yr 2000 = simulation of year 2000 conditions with Plan A point sources for urban area.
[3] Last precipitation prior to 10 Aug 68 was 0.2 in. on July 19. Simulation between 1 Aug and 15 Aug has nitrification treatment for City STP point source.
[4] Last precipitation prior to 25 Aug 68 was 0.13 in. on Aug 23. Simulation between 15 Aug and 31 Aug does not have nitrification treatment for City STP and has coliform at 800 org/100 ml.

Simulation Modeling of Water Quality

General Methodology. A requirement of the study was the development of a mathematical model capable of simulating the hydrologic and water quality response of the study area. The simulation model had two roles:

1. As a tool in this study and

2. As a tool for ongoing research after the completion of this study.

The Hydrocomp Simulation Programing (HSP) was selected as the most appropriate base for developing a simulation specific to the watershed of the study area. HSP is a proprietary software which is the property of Hydrocomp, Inc., Palo Alto, California. HSP consists of algorithms for the calculation of the hydrologic cycle processes onto which other algorithms are superimposed for the chemical and biological processes occurring on land surfaces and in streams and impoundments. The algorithms are general for any watershed. The simulation is made specific by the insertion of a data base specific to a watershed followed by a calibration process.

Results. Table 6 contrasts the no-point source (NPS) and year 2000 water quality conditions for significant locations on the Spokane River, including Long Lake. The pertinent points are summarized below.

1. Spokane River above the Hangment Creek confluence:

- Although phosphorus removal of wastes is taking place, there is significant biological activity at year 2000 conditions in response to the natural phosphorus additions. This activity affects the performance of the river with respect to dissolved oxygen (DO).

- The simulation shows an increase in DO at year 2000 over NPS conditions, indicating that the impact of the biological activity in adding oxygen is greater than the effect of the added BOD is depressing the oxygen supply.

- The high bacterial counts in the Spokane Valley SPT effluent tend to mask the impact of the Spokane Valley SPT effluent. Consideration of the dilution of the Spokane Valley STP effluent to 60 to 1 at low river flows on 10 August 1968 and over 100 to 1 on 25 August 1968 respectively explains the insignificant impact.

- The amount of ammonia does not reach dangerous levels below the Spokane Valley STP without nitrification due to the high dilution ratio.

- The impact of the industrial cooling watershed is shown to be only 0.1°C. The impact of sunlight and groundwater interchange are much more significant in this reach. There is an approximate 2-degree drop from the boundary condition due to groundwater interchange and a diurnal change of approximately 3 degrees due to sunlight.

- In general, it can be concluded from the simulation that the combined Spokane Valley STP and industrial loads would not degrade the river below Class A standards.

2. Spokane River downstream from City of Spokane STP:

- DO is raised by the biological activity in daylight more than it is depressed by the added BOD.

- The biological activity, as a result of added nutrients in combination with the high water temperatures, is very large.

- The chlorophyll A values at the low flow on 10 August 1968 reach 48.5 ug/l, and the biomass has already utilized most of the added phosphorus as indicated by the drop of Ortho P to .006 mg/l and increase of potential P to .069 mg/l.

- With nitrification, the ammonia level is shown to be at a safe level of 0.048 mg/l but without nitrification at low river flows and higher dilutions, which did occur on 25 August 1968, the ammonia level reaches 0.305 mg/l, a level of concern.

Utilization for Further Study. The calibration and production runs made under this study by no means exhaust the potential of this tool for planning, regulatory or research purposes. Some of the potential applications that are apparent at this time are briefly given below.

1. There may by unforeseen or unanticipated changes in conditions or regulatory requirements that will provide opportunities for use. The trend in regulatory practice is to express requirements in statistical terms rather than a single fixed not-to-be exceeded value. As requirements become more stringent, statistical expression is expected to be utilized to achieve these ends economically. An example is regulatory requirements for the urban runoff; they can hardly be expressed in other than statistical terms.

2. The consideration of control of riverflow and water temperature could be tested with the simulation model.

3. It is possible to evaluate riverflow operating policies to determine the optimum procedure accounting for both water quality and power generation.

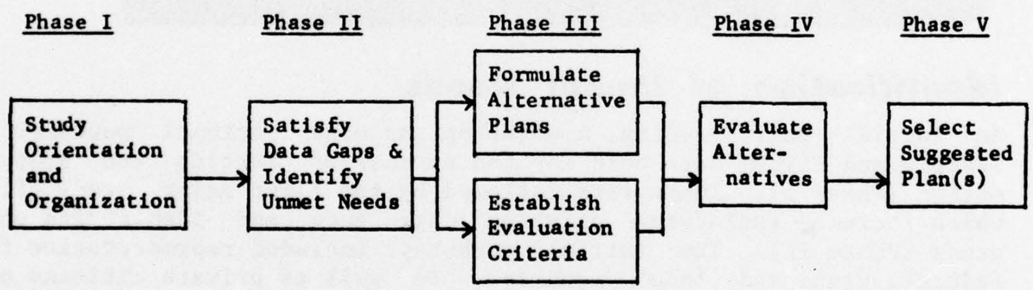
SECTION VI

PUBLIC INVOLVEMENT AND PLAN FORMULATION FOR WASTEWATER MANAGEMENT

VI. Public Involvement and Plan Formulation for Wastewater Management

Introduction

Formulation of wastewater management plans for this study was accomplished in five phases, each intimately related to the study's public involvement program. This process is diagrammed in the following flow chart.



FORMULATION OF WASTEWATER MANAGEMENT PLANS FLOW CHART

Facilitating this interaction was a total of 27 meetings with the local technical advisory committee (SPRIBCO), 16 meetings with the citizens committee (CITCOM), three public workshops and two public meetings. For information concerning the organization of SPRIBCO and the CITCOM see section 1, Study Management. In addition, approximately 30 pages of handout materials were distributed to members of CITCOM and SPRIBCO. Four study brochures were published and five newsletters were mailed to everyone on the study's mailing list of more than 700 individuals and businesses. Numerous articles appearing in newspapers throughout the study, as well as radio and television coverage of the study's key local issues, helped to create and maintain the public's interest in the study.

Identification of Unmet Needs

An initial public meeting, a workshop and organizational meetings of SPRIBCO and CITCOM were held for the purpose of setting the study in motion (Phase 1). These were followed by the first major study effort which included satisfying existing data gaps and identifying unmet needs (Phase II). The initial workshop included representation from Federal, State and local agencies, as well as private citizens concerned with water resources in the Spokane River basin. Discussion of related studies, available information and known planning needs in the basin served as a help in getting Phase II underway. SPRIBCO and CITCOM actively participated in this phase also by holding a total of 16 meetings, culminating with a public workshop, where these topics were a key part of the agenda. Seven basic information topics were highlighted at these meetings:

- Groundwater Quality
- Groundwater Quantity
- Surface Water Quality
- Surface Water Quantity
- Environment
- Water Sources and Water Systems
- Wastewater Sources and Wastewater Systems

From these discussions, 73 planning (unmet) needs were identified. A brochure/workbook was prepared and distributed to persons on the study's mailing list for the purpose of soliciting reactions and further input. More than 200 comments were received from which the following identified needs were given general support:

- The potential for gradual contamination of the primary ground-water aquifer due to increasing urbanization in the Spokane Valley (see sections V and VI).

- Efficient use of the groundwater resource (see sections III and X).

- The effects of overflows to the Spokane River from combined sanitary and storm sewers (see sections IV and V).

- The means by which independent water service agencies might realize increased operational efficiencies (see section X).

- The increasing eutrophic characteristics of many lakes in the study area (see sections V and XI).

- Areas along the Spokane River, Little Spokane River and Hangman Creek that experience flood damage (see section VIII).

- Areas within the Spokane region that experience urban runoff problems (see section IX).

The reference following each of the above needs notes pertinent discussions in this report relating to the problem. In addition, these public attitudes and concerns were a basic consideration in preparing the evaluation criteria for selecting wastewater management alternatives.

Formulation of Alternative Plans

Two considerations basic to all wastewater management systems are (1) a delineated service area providing wastes to be treated and (2) a technique for disposing of the treated by-products. Within the study area three main service areas (see figure 8) contain more than 85 percent of the population: (1) the City of Spokane, (2) North Spokane and (3) Spokane Valley. Five combinations of these service elements are possible, ranging from all independent to all combined.

Considering the 1983 best practicable waste treatment technology (BPWTT) criteria of PL 92-500, there are essentially two disposal categories considered applicable: (1) disposal to surface water and (2)

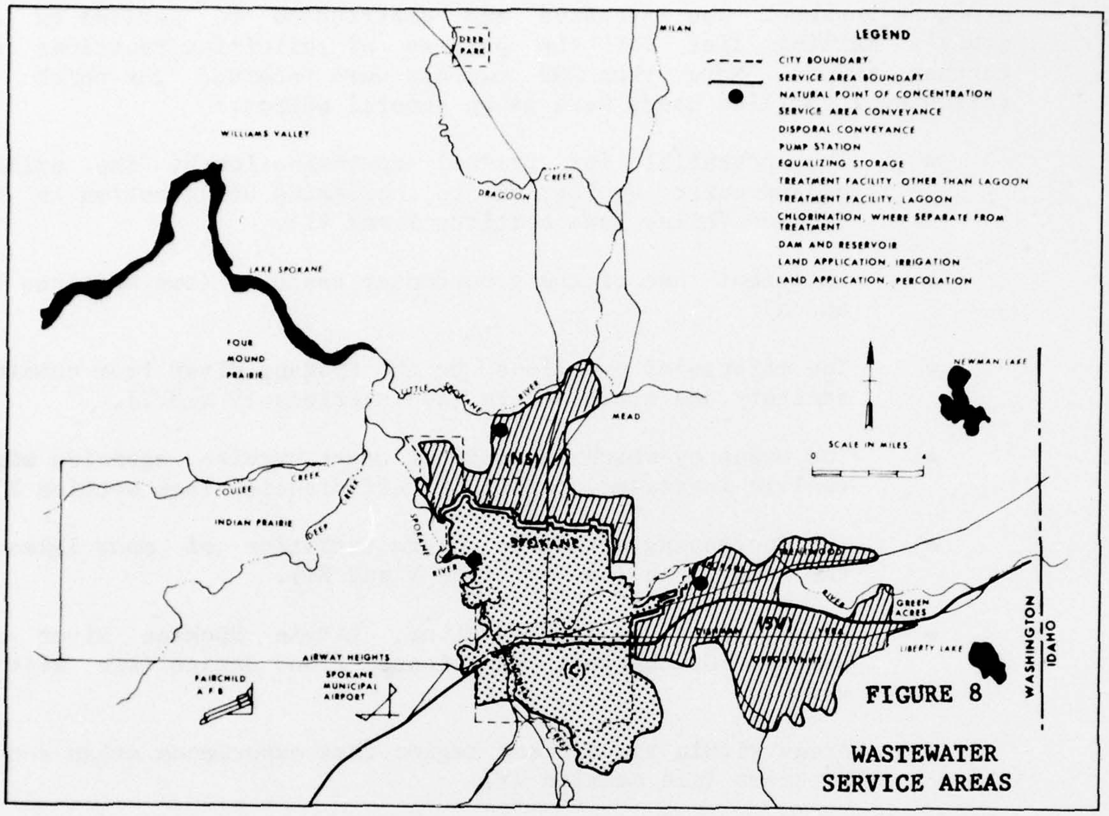


FIGURE 8

WASTEWATER SERVICE AREAS

disposal by land application through irrigation or percolation. Combining these disposal techniques with the available service areas results in an inclusive list of 57 possible service area/disposal conceptual plans. "Disposal by land application" hereinafter includes effluent which has received advanced treatment prior to disposal by land application through irrigation or percolation.

Establishment of Evaluation Criteria

Concurrent with the formulation of conceptual plans (an activity primarily involving the study staff), the study's technical and citizen's committees held a total of six meetings where their efforts were concentrated towards identifying evaluation criteria for later use in selecting alternatives. The final thirty-one factors listed in table 7 resulted after consideration of more than 70 elements.

TABLE 7

THIRTY-ONE EVALUATION CRITERIA

Concerns		Criteria
1. Cost-Effectiveness	*a.	Present worth of the sum of capital and O&M costs.
	b.	Is most cost-effective.
2. Direct Economic Concerns	a.	Has lowest requirement for capital.
	b.	Has lowest annual O&M cost.
	c.	Causes minimum loss of employment and real income due to displacement.
	*d.	Causes minimum loss of tax revenue due to displacement.
3. Indirect Economic Concerns	a.	Has maximum favorable impact on attractiveness to business and rise in level of economic activity.
4. Transient Economic Concerns	a.	Has maximum potential for local employment increase during construction.
	b.	Has maximum potential for increase in local manufacture and supply activity during construction.
	c.	Will cause minimum disruption of circulation and business activity during construction.
5. Social Concerns for the Community	a.	Has most favorable impact on health, welfare and safety.
	*b.	Causes the least disruption to existing community living patterns.
	c.	Has the most beneficial impact on availability of recreation.
	d.	Introduces the least constraints to land use and land use planning.
6. Social Concerns for the Individual	a.	Causes the least dislocation of individuals from their homes, employment and general pattern of cultural activity.
7. Concerns for Groundwater	*a.	Provides maximum protection of groundwater quality.
8. Concerns for Surface Water	*a.	Provides maximum protection or enhancement of surface water quality for all concerns.
9. Concerns for Land Use	a.	Preserves or increases land available for wildlife habitat, natural vegetation and open space.
	b.	Preserves or enhances the aesthetic value of the landscape.
	c.	Creates least interference with other beneficial land uses.
10. Concerns for Air Quality	a.	Provides maximum protection of public health aspects of air quality.
	b.	Provides minimum potential for deterioration of aesthetic quality of air.
11. Concerns for Energy and Resources	a.	Requires minimum input of 10°kwh electrical energy.
	b.	Requires minimum input of chemicals.
	c.	Provides the maximum opportunity for energy and resource recovery.
	*d.	Has lowest net energy requirement considering recovery.
12. Performance Evaluation	*a.	Provides best technical performance in wastewater renovation.
	b.	Provides highest degree of reliability.
13. Flexibility	*a.	Has maximum flexibility to meet unanticipated changes in growth.
	b.	Has maximum flexibility in adapting to changes in disposal criteria.
	c.	Has maximum flexibility to incorporate changes in technology of wastewater treatment.

*These evaluation factors were used by the Citizens Committee in their evaluation efforts, since these eight indicate a wide range of performance between alternatives. The fact that Item 5a concerning Health, Safety and Welfare, for example, is not included does not mean that this factor lacks importance. Rather, the level of protection provided by all plans for this evaluation factor is so high that the minor differences provided by each plan should not be given great weight differences in the selection process.

Evaluation of Alternatives

Due to the total number of conceptual service area/disposal alternatives identified, a decision was made to begin the evaluation process with a cost-effective screening. This provided a means for selecting the alternatives to receive a more detailed evaluation. For each of the 57 alternatives a net present worth value was determined for capital, operation and maintenance costs over a twenty-year planning period (1980 to 2000).

The treatment systems used in preparing the cost-effective screening consisted of the following:

1. For disposal to surface water; activated sludge treatment with chlorination.

2. For disposal by land application through irrigation following lagoon aeration and chlorination.

3. For disposal by land application through percolation and advanced treatment and chlorination.

For all evaluations, the same solids disposal alternative is applied throughout, namely anaerobic digestion, vacuum filtration and track haul to a sanitary landfill. An exception is made where lagoon treatment is used. Details of criteria considered in the screening process are contained in figure 9.

As a result of the cost-effective analysis, the following alternatives were selected, with the assistance of SPRIBCO, for further detailed evaluation. The systems chosen were not necessarily the lowest in overall cost, but rather represented the lowest cost alternative for a variety of service area/disposal technique arrangements, as well as optimization of one or more evaluation factors listed in table 7.

Plan A. The City and North Spokane are combined to form a subsystem using the upgraded City STP with surface water disposal. The Spokane Valley is provided separate treatment at a valley location with surface water disposal. This selection is made for its lowest cost and represents traditional surface water disposal.

Plan B. Separate treatment and disposal are provided for each service area: the City to utilize its upgraded treatment plant with surface water disposal; North Spokane to use lagoon treatment and land application of the effluent by irrigation; and Spokane Valley to use a separate valley treatment plant and surface water disposal. This plan is selected as an example of an institutionally independent system wherein each service area provides its own facilities. Also included is disposal by land application through irrigation for the North Spokane element where the net cost for irrigation is lowest.

1. For all alternatives using surface water disposal, costs were determined for both year-round and seasonal phosphorus removal for the condition that 1983 standards will be in effect throughout the planning period.

2. Costs were identified for the condition that 1983 standards would be in effect from 1980 to 1990 and the interpreted 1985 standards would be in effect from 1990 to 2000.

3. The cost for using primary-treated effluent in lieu of secondary-treated effluent for irrigation was identified.

4. The cost of seasonal disposal to land application for irrigation with excess going to surface water disposal was determined.

5. The cost of adding complete nitrification-denitrification to the pretreatment requirements for percolation at the downriver site was also included.

6. Costs of lands and rights-of-way are based on estimates of 1974 market value as determined by the County Assessor.

7. Conveyance structures such as sewers and force mains are sized for year 2020 forecast flows and are constructed in a single stage. Prior substudies indicate no significant difference in present worth for staged construction in the increments needed for this study.

8. The City STP with presently proposed improvements is assumed to be a sunk capital cost. Operation and maintenance costs are not regarded as sunk.

9. All required additions to the presently proposed improvements of the City STP and all other treatment facilities are sized for year 2000 flows.

10. Land application alternatives are priced on the assumption that all required lands will be purchased and owned by the wastewater management agency and that the net income, if any, from operation of the land will accrue to the agency.

11. Stage construction is utilized for treatment facility expansion and for land application installations.

12. Land purchased for reservoir storage includes an allowance for ultimate expansion to year 2020 needs. The dam is constructed to year 2000 needs.

13. Cost estimates for storage reservoirs are based on estimated earthwork volume for the specific sites selected.

14. Costs of internal sewerage within service areas, which are common to all alternatives except the Spokane Valley no action alternative, are not included for cost screening purposes.

FIGURE 9

ALTERNATIVES COST SCREENING ELEMENTS AND CRITERIA

Plan C. All three service areas are combined to use the upgraded City STP with surface water disposal. This plan is selected as a representative of a lowest cost regional plan using a single integrated physical system.

Plan D. This plan is the same as Plan A until 1990, at which time both systems are converted from surface water disposal to land application

by rapid percolation. Plan D is selected for future adoption because it is the most cost effective method of upgrading treatment under 1983 standards to 1985 goals.

Plan E. The City and North Spokane are combined to form a system using the upgraded City STP but with summer season disposal by land application through irrigation and winter season disposal to surface water. Spokane Valley is provided separate treatment and year around disposal by land application through irrigation. Plan E is selected as the most cost effective representative of land application for the entire service area. It should be noted that this plan also represents the system of seasonal land application, with surface water disposal as the off season method.

Plan F. Again the City and North Spokane combine into a system using the upgraded City STP and Spokane Valley is provided with separate treatment. Both subsystems utilize year-round disposal by land application through irrigation. (All plans utilizing year around disposal by land application through irrigation include storage for the effluent during the non-irrigation season.) Plan F is selected to represent total land application of all wastewater flows from all service areas. This system represents complete reclamation for irrigation use and full-time compliance with interpreted 1985 goals.

Plan G. This plan combines North Spokane and Spokane Valley into a unified subsystem with lagoon treatment and year-round disposal by land application through irrigation. The City remains separately served by its upgraded STP, utilizing surface water disposal to 1990, at which time disposal is converted from surface water to year-round land application by rapid percolation. Plan G is selected to represent those systems which combine County area, with City separate. A system with land application from the start for North Spokane plus Spokane Valley is selected and combined with a City system starting with surface water disposal and then being upgraded to interpreted 1985 goals. This system is also selected for its better cost position relative to Plan D than is offered by Plans E or F.

Plan H. This plan provides separate treatment and disposal for all three service areas. All three, including North Spokane, are provided with surface water disposal. This plan is selected to represent the same condition for North Spokane as in the present County Adopted Plan.

Plan I. This is the "no action" plan which provides for the City to use its own upgraded STP for surface water disposal, North Spokane to continue with a mixture of on-site disposal and interim lagoon facilities and Spokane Valley to continue with on-site disposal.

Detailed evaluation of these nine alternative plans involved a series of six SPRIBCO and CITCOM meetings. While the study staff evaluated all alternatives with respect to each of the thirty-one evaluation

factors, CITCOM and SPRIBCO limited their evaluation efforts to the eight factors noted in table 8. Based on each individual's priorities, the alternative plans were evaluated and ranked. Table 8 presents a narrative summary of these evaluation results. As stated, Plan A was selected by local interests to be the best overall system for satisfying the 1983 requirements of Public Law 92-500, while Plan D best satisfies the interpreted 1985 goals for upgrading Plan A.

Sludge Management Alternatives

As a component of wastewater management systems, sludge management alternatives also were evaluated. The City STP, upgraded and expanded in accordance with State of Washington DOE directives, is a major element in all alternative wastewater management plans considered by this study. A complete sludge (sewage solids) processing system consisting of anaerobic digestion, vacuum filtration and sanitary landfill is included as part of the committed plans for upgrade and expansion. DOE contracted with Bovay Engineers, Inc., to evaluate sludge disposal alternatives, particularly land application, as related to the upgraded and expanded City STP.

For purposes of the Corps of Engineers' study, sludge management alternatives formulated by DOE for the City STP were used. In addition, a comparable set of alternatives was prepared by the Corps for Spokane Valley. The following sludge management alternatives, listed separately for the City STP and Spokane Valley, were the final candidate plans surviving a preliminary screening process.

1. Sludge Management Alternatives for the City STP:

- Plan S. Anaerobic digestion, vacuum filtration and final disposal to sanitary landfill. (The system included in the committed plans for enlargement and upgrading.)

- Plan T-1. Anaerobic digestion, dry farm land application at Indian Prairie.

- Plan T-2. Anaerobic digestion, irrigation land application at Indian Prairie.

- Plan V. Anaerobic digestion, vacuum filtration, incineration, land fill ash.

- Plan W. Anaerobic digestion, vacuum filtration, drying and marketing by others.

- Plan X. Concentration of raw sludge, high pressure wet oxidation (70%), vacuum filter separation of solids, final disposal to landfill.

TABLE

IMPACT ASSESSMENT FOR CANDIDATE

EVALUATION FACTORS	TENTATIVELY RECOMMENDED ALTERNATIVE PLAN A	ALTERNATIVE PLAN B	ALTERNATIVE PLAN C	TENTATIVELY RECOMMENDED ALTERNATIVE PLAN D
Has lowest total cost for the planning period.				
Total Cost (capital plus O&M)	$42,000,000	$51,300,000	$53,800,000	$58,000,000
Annual Cost (capital plus O&M)	$ 4,000,000	$ 4,800,000	$ 5,100,000	$ 5,500,000
Causes minimum loss of tax revenue.	Land with market value of approximately $26,000 required.	Land with market value of approximately $1,300,000 required.	Land with market value of approximately $3,500 required.	Land with market value of approximately $1,200,000 required.
Causes least disruption to community living patterns.	Negligible disruption.	2,400 acres will be required for lagoons, storage and irrigation.	Negligible long term disruptive impact.	There will be a minor dislocation at the site for percolation.
Provides maximum protection of groundwater quality.	Some impact. Eliminates all waste discharge to the groundwater, except that due to river interchange with the groundwater downstream from SV discharge.	Part to irrigation on a minor aquifer. Low threat to groundwater.	Eliminates all waste discharge to groundwater except minor river recharge downstream from City sewage treatment plant.	Until 1990 this plan eliminates all waste discharge to groundwater except that due to river interchange downstream from SV discharge. After 1990, SV discharges to ground near downstream end of primary aquifer.
Provides maximum protection of surface water quality.	All treated wastes are discharged to surface water. Protection depends on degree of treatment and system reliability.	Only a small part of total to land disposal. Protection of surface water depends on degree of treatment and system reliability.	Surface water discharge concentrated at one point. Protection depends on treatment system and reliability.	Until 1990 this plan is a surface water discharge system. No surface water discharge after 1990.
Has lowest net energy requirement.	Has lowest net energy requirement (272×10^6 Kwh).	Has second lowest net energy requirement (307×10^6 Kwh).	Has 4th lowest net energy requirement (354×10^6 Kwh).	Has 5th lowest net energy requirement (493×10^6 Kwh) of all plans.
Provides best technical performance of wastewater renovation.	Two surface water discharges from activated sludge secondary treatment plants do not accomplish a high wastewater quality renovation.	The NS service area has irrigation treatment, but the City and SV have separate surface water disposals from activated sludge secondary treat-plants which reduce the overall renovation capability of the plan.	One large single plant favors quality performance over smaller plants, but renovative quality from secondary treatment alone is less than that possible with treatment by land.	Surface water discharge to 1990 result in renovation similar to Plan A. The addition of land percolation treatment after 1990 improves the plan's overall renovation quality.
Has maximum flexibility for unanticipated growth.	The primary unfavorable element is the conveyance from NS to the City. The City treatment site has capacity for expansion well beyond the forecast needs of NS and C combined. The conveyance for SV is the shortest of any plan. Expansion at SV site should be feasible.	Three separate treatment plants favor flexibility. The City plant has extra capacity without construction and requires no conveyance. The SV site is favorable for expansion and has the minimum conveyance for this service area. The only inflexible elements are the NS conveyance to lagoon treatment site and the storage reservoir.	Three unfavorable elements: least difficult is NS to City conveyance; next most critical is forecast flows for the three service areas approach capacity of City treatment site and might require a supplementary second site; most critical is SV convevance thru the City. Construction would be expensive and disruptive; to increase capacity with a parallel line at a later date would be even more so.	Has the same flexibility characteristics of Plan A to 1990. The delay in going to more refined treatment is an advantage to flexibility. There are major conveyance structures which introduce some inflexibility. The percolation treatment can be expanded in stages.
SUMMARY (Rank-year)	(1st-1983) Best for satisfying the 1983 requirements of PL 92-500.	(4th-1983) Ranks 4th in satisfying 1983 requirements of PL 92-500.	(2nd-1983) Ranks 2nd for satisfying 1983 requirements of PL 92-500.	(1st-1985) Best for satisfying the interpreted 1985 goals of PL 92-500.

8

WASTEWATER MANAGEMENT PLANS

ALTERNATIVE PLAN E	ALTERNATIVE PLAN F	ALTERNATIVE PLAN G	ALTERNATIVE PLAN H	ALTERNATIVE PLAN I (No action)
$95,100,000	$132,200,000	$70,400,000	$47,300,000	No additional costs beyond existing capital and O&M costs (to include the updated City sewage treatment plant).
$ 9,000,000	$ 12,500,000	$ 6,600,000	$ 4,500,000	
Land with market value of approximately $5,000,000 required.	Land with market value of approximately $12,000,000 required.	Land with market value of approximately $4,200,000 required.	Land with market value of approximately $62,500 required.	
This plan will have major disruptive potential on approximately 15,000 acres of rural land.	This plan will have major disruptive potential on approximately 18,900 acres of rural land.	6,700 acres will be required for lagoons, storage and irrigation.	Negligible disruption.	No additional disruption over present conditions.
No direct discharge to groundwater, but potential recharge from irrigation to basalt aquifer by C and NS and to Peone Prairie by SV.	No direct discharge to groundwater, but potential recharge to Dragon Creek aquifer by percolation from irrigation.	No direct discharge to the ground until 1990, which will be at the downstream end of the primary aquifer below the point of present significant use.	Eliminates all waste discharge to groundwater except that due to river interchange downstream from SV discharge.	Leaves groundwater quality questionable due to septic tank discharges to ground.
For the C+NS portion, surface water discharge is eliminated only during the summer.	No direct surface water discharge. There is some potential for washoff to surface water from irrigated areas.	Surface water disposal by the City until 1990. After 1990 only indirect return from disposal by percolation. For NS and SV there is some potential for washoff to surface water from irrigated areas.	All treated wastes are discharged to surface water. Protection depends on the degree of treatment and system reliability.	Leaves surface water quality questionable due to minimum treatment provided by SV and NS.
Has the 7th lowest net energy requirement (860 $\times 10^6$ Kwh).	Has the 8th lowest net energy requirement (1157 $\times 10^6$ Kwh).	Has the 6th lowest net energy requirement (554 $\times 10^6$).	Has second lowest (along with Plan B) net energy requirement (309$\times 10^6$Kwh).	No additional energy required beyond current O&M needs.
Full time irrigation treatment for SV service area and summer season irrigation treatment of C and NS service areas provide very high renovation quality. Winter surface water discharge for C and NS detracts from overall renovation quality of the plan.	Full time land treatment by irrigation gives this plan the very highest wastewater renovation capability.	Land treatment by irrigation for the NS and SV service areas provides high quality renovation. The proposed treatment for the City offers good renovation.	Three separate surface water disposals from activated sludge plants provide lowest quality wastewater renovation of all plans.	Wastewater discharges from NS and SV service areas remain at a low renovation level.
Major conveyance systems required by this plan, including a river crossing and high head pumping and storage reservoirs make this plan rather inflexible.	Very inflexible due to major conveyance facilities and storage reservoirs required. The conveyance from the City to Williams Valley is the longest of any plan and would constitute a major problem for enlargement to meet unforseen growth.	Major conveyance facilities, which restrict system flexibility, are a part of this plan. For the City service area construction is postponed until 1990. This removes significant risk of unanticipated growth rates.	Separate treatment facilities for each major service area and no conveyance facilities make this plan very flexible to unanticipated growth.	Upgraded City treatment facility has capacity for expansion beyond forcast needs of NS and C combined.
(5th-1983) **Ranks 5th in satisfying 1983 requirements of PL 92-500.**	(3rd-1985) **Ranks 3rd in satisfying the interpreted 1985 goals of PL 92-500.**	(2nd-1985) **Ranks 2nd overall in satisfying the interpreted 1985 goals of PL 92-500.**	(3rd-1983) **Ranks 3rd in satisfying 1983 requirements of PL 92-500.**	**Ranks last. Does not satisfy either 1983 or the interpreted 1985 requirements of PL 92-500.**

2. Sludge Management Alternatives for Spokane Valley:

- Plan S. Anaerobic digestion, vacuum filtration, sanitary landfill.
- Plan T. Anaerobic digestion, vacuum filtration, land application to dry farm.
- Plan V-1. Centrifugation of raw sludge, multiple-hearth incineration.
- Plan V-2. Anaerobic digestion, vacuum filtration multiple-hearth inceneration.
- Plan X. Wet oxidation (70% reduction), centrifuge separation of solids.
- Plan Y. Deliver raw sludge to City STP for processing and disposal.

Both sets of alternatives were evaluated respective of environmental, social and economic concerns. For both the City and North Spokane combined, and Spokane Valley, Plan S was found to be the most favorable in terms of cost and environmental considerations. This is consistent with the system currently being implemented by the City in upgrading their waste treatment system.

Non-structural Alternatives

The non-structural wastewater management alternatives considered by this study are listed in table 9. Generally it is concluded that no individual non-structural wastewater management policy or combination of non-structural alternatives will have sufficient impact to influence the configuration of the recommended structural alternative plan. It can be hoped that application of non-structural wastewater management concepts may influence the efficiency of structural alternatives, thus affording benefits in reducing system cost as well as hoped-for improvements to flow quantity and quality. However, local planning at this time cannot assume that this will happen. It seems apparent that the greatest expectancy of successful application of non-structural wastewater alternatives are those measures which incorporate some means of economic incentive. Table 9 indicates the four measures ranking highest in the study evaluation.

Selection Of Suggested Plan

The plan formulation effort culminated with preparation and distribution of a brochure summarizing the study findings. Approximately 1200 copies were distributed to all individuals on the study mailing list and other interested citizens, businesses and public agencies.

TABLE 9

NON-STRUCTURAL WASTEWATER MANAGEMENT ALTERNATIVES

Rank[1]	Alternatives	Methods
	REGULATORY MEASURES	
4	Land Use Controls	Zoning Covenants Building Regulations
2	Health Regulations	Soil Restrictions Groundwater Locations Well Locations Parcel Area
	Water Use Controls	Cooling Wet Industries Reuse General Reuse
1	Waste Generation Charges	Large Quantities High Strength Reuse Credit
	NON-REGULATORY MEASURES	
3	Waste Source Reductions	Population Control Reclamation & Refuse Relocate Waste Producers Discourage Solid Wastes Industrial Pre-Treatment
	Economic Incentives	Tax Benefits User Fees Grant Restrictions Housing Subsidies Environmental Pollution Tax
	Water Conservation	Public Awareness Fixture Modifications
	Efficient Land Use	Cluster Development Multiple Dwellings Utility Corridors

[1]Ranking based on study evaluation results.

Within a month after distribution of these brochures, the final public meeting for the study was held in Spokane. This meeting provided an opportunity to present and discuss the final study conclusions and suggestions (both structural and non-structural) for all aspects of the study, including wastewater management, flood damage prevention, urban drainage and related water use. Nearly 200 persons attended the meeting. Comments received, both written and oral, as a result of this meeting are contained in section XII, Review Comments.

The development, screening and evaluation of alternatives lead to the conclusions that the best system to meet the 1983 requirements of PL 92-500 is Plan A and the best system to meet anticipated 1985 goals is Plan D. These are also most cost-effective plans.

Plan A provides for the following:

1. Wastewater treatment at existing City STP (upgraded) for City and North Spokane with disposal to surface water.

2. Separate treatment facility near Felts Field, at an appropriate time in the future, to serve Spokane Valley with disposal to surface water. Also suggested is the adoption of a future contingency plan to upgrade Plan A to Plan D to meet 1985 interpreted goals of PL 92-500 by addition of land disposal by rapid percolation. This will require reservation of percolation sites for City-North Spokane and Spokane Valley subsystems.

<u>Description of Plan A</u>. Plan A (see figure 10) proposes surface water disposal throughout the entire planning period, 1980 to 2000, with treatment to 1983 standards. The combined flows from the City and North Spokane are treated in the upgraded City plant for disposal to the Spokane River. North Spokane would be sewered to a natural point of concentration in the vicinity of the fish hatchery near the Little

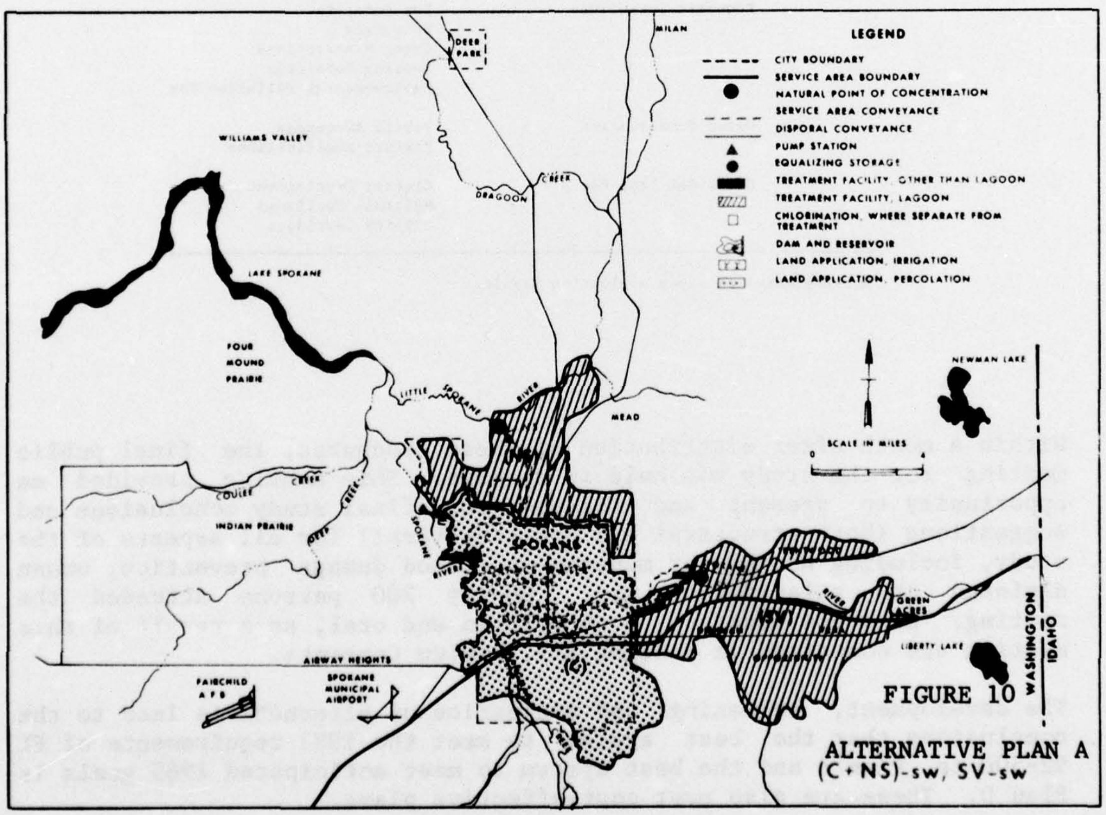


FIGURE 10

ALTERNATIVE PLAN A
(C+NS)-sw, SV-sw

Spokane River from which point the sewage would be pumped to the City STP, a distance of approximately 8.8 miles. This involves a static lift of 425 feet provided by two lift stations. Plan A can accommodate the west plains area under projected conditions. The developed areas west of Five Mile Prairie are added to the force main by a separated lift station. Because raw sewage is being conveyed, the pump stations include standby power and pumping capacity to insure operation at all times. The City service area is sewered to the present treatment site; future growth areas, including some of Moran Prairie and Southwest would be added to the basic collection system.

The City STP is being improved and expanded to a 40 mgd secondary facility utilizing an activated sludge process with provision for chemical removal of phosphorous. The improved plant will have adequate capacity for the combined City and North Spokane service areas to year 2000. No basic addition to the City facility is included in Plan A, except minor modification to permit a degree of seasonal nitrification. Disposal would be to the Spokane River adjacent to the plant at river mile 67.2.

Plan A can also accommodate the West Plains area under projected conditions. On the basis that Spokane Valley would eventually require sewering, Plan A includes Spokane Valley.

A treatment plant for the Spokane Valley would include an activated sludge secondary treatment plant constructed in one stage, including chemical removal of phosphorous. Disposal would be to the Spokane River by submerged outfall downstream from the City well system.

Total cost of Plan A is $42 million. This includes capital cost and operation and maintenance costs for the main trunk sewer line and the treatment and disposal facilities.

Description of Plan D. Plan D (see figure 11) is the same as Plan A except that both the City-North Spokane and the Spokane Valley service areas would be phased to rapid percolation in 1990. The shift to rapid percolation disposal at 1990 is in response to an assumption that more stringent standards for surface water disposal are imposed at that date.

The incremental construction in 1990 includes development of the rapid percolation site for the combined flows of the City and North Spokane on the terrace adjoining Long Lake. The required conveyance from the City STP to the percolation site consists of approximately 12.6 miles of force mains, gravity sewers and pump stations for a total static lift of 186 feet. Equalizing storage is also provided for effluent pumping. After completion of the percolation sites and conveyance structures, the operation of the City STP would be altered to eliminate phosphorous removal which would no longer be needed for percolation disposal. A possible addition will be nitrification-denitrification facilities if future groundwater standards so dictate.

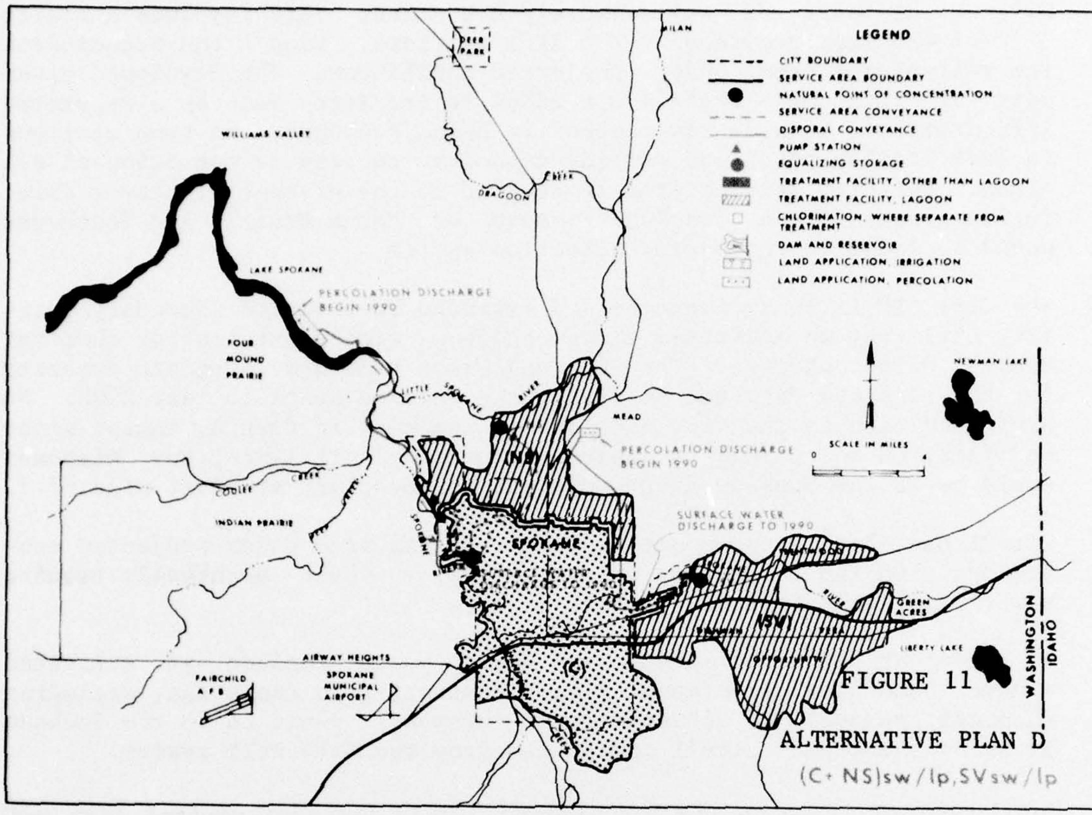


FIGURE 11

ALTERNATIVE PLAN D

(C+NS)sw/lp,SVsw/lp

The rapid percolation site for the Spokane Valley is in the vicinity of Mead on the downstream end of the primary aquifer. The required conveyance from the Spokane Valley treatment facility to the percolation site will have been partially constructed in the first phase as an element of the conveyance downstream for surface water dispoal. The total added length is approximately 8.2 miles and includes a static lift of 137 feet. The 10 mgd Spokane Valley treatment plant, built as an activated sludge secondary plant with chemical phosphorous removal, would be modified in 1990, with the advent of percolation disposal, to discontinue the operation of chemical phosphorous removal. However, nitrification-denitrification facilities may be required if future groundwater standards dictate.

The total cost of Plan D is $58 million which is a $16 million increase over Plan A. A comparison of the total and annual costs for alternative wastewater management plans is illustrated in figure 12. The total cost for individual alternative plans satisfying the 1983 standards of PL 92-500 range from $42 million for Plan A to $95.1 million for Plan E. Among alternative plans satisfying the interpreted 1985 goals of the law, the total cost of the plan range between $58 million for Plan D to $132.2 million for Plan F.

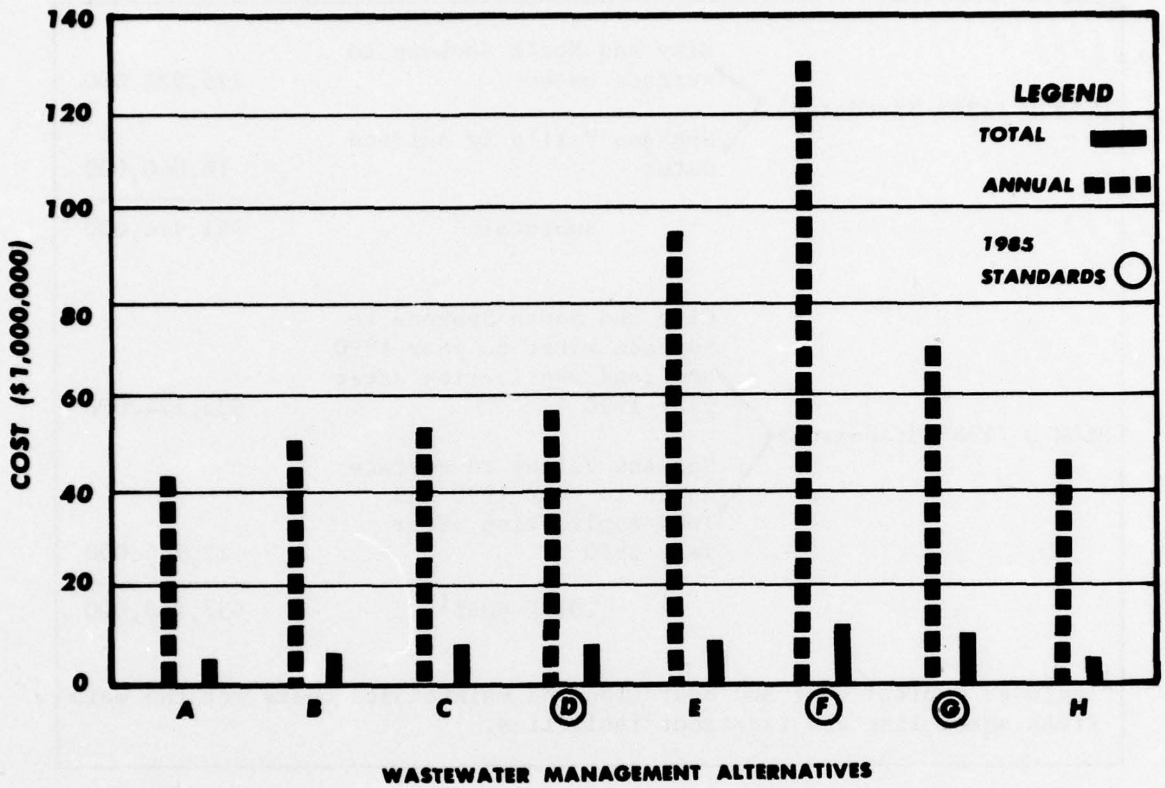


FIGURE 12

TOTAL AND ANNUAL COSTS

Figure 13 provides elemental costs of Plans A and D.

Implementation of the Selected Plan

The following elements are correlated suggestions for implementing Plans A and D.

1. Implement inter-local cooperation agreement between the City and County to provide planning, management and funding of the unified subsystem for the City and North Spokane service areas.

2. Implementation by the County of the community sewerage facility for Spokane Valley service area.

PLAN A (1983 Standards)	City and North Spokane to surface water	$25,924,000
	Spokane Valley to surface water	16,040,000
	Subtotal	$41,974,000
PLAN D (1985 Standards)	City and North Spokane to surface water to year 1990 and land application after year 1990	$35,174,000
	Spokane Valley to surface water to year 1990 and land application after year 1990	22,784,000
	TOTAL COST[1]	$57,958,000

[1]Includes capital cost and operation and maintenance costs for the main trunk sewer line and treatment facilities.

FIGURE 13

ELEMENTAL COST SUMMARY

3. **Revise the discharge permit for the upgraded City STP to provide for evaluation of the feasibility of seasonal phosphorous removal through trial operation for at least two consecutive representative years.**

4. **Utilize the sludge processing and disposal system of the upgraded City STP, namely anaerobic digestion, vacuum filtration and track haul to sanitary landfill.**

   a. Formulate a plan for data gathering through pilot operation to evaluate criteria for land application of sludge using local soils and crops.

   b. Establish a program to update the potential for land application as an alternative sludge disposal method in line with changing technology and cost of fertilizer chemicals.

5. Adopt a planning policy to phaseout onsite sewerage disposal in Spokane Valley in favor of a community sewerage collection and disposal system.

   a. Establish a commission, made up of the responsible regulatory agencies which are concerned with water quality control and public health, to generate policy for onsite sewerage disposal in the Spokane Valley as a firm basis for necessary planning and implementation actions by Spokane County. The commission membership should include U.S. Environmental Protection Agency, State of Washington Department of Ecology, State of Washington Department of Social and Health Services and the Spokane County Health Department.

   b. Apply to Environmental Protection Agency for "Sole-source" classification of Spokane aquifer under provisions of Public Law 93-523 (Safe Drinking Water Act).

   c. Implement a program for groundwater quality sampling and testing at various levels of the saturated zone within the aquifer to evaluate the effect of recharge waters from surface activities.

   d. Establish land use planning goals reflecting wastewater disposal needs.

   e. Implement community sewerage in Spokane Valley through incremental construction. This would include initially establishing a "corridor" of sewer service along the most heavily built-up concentrations of commercial, industrial and multiple unit dwellings.

   f. Adopt a sludge treatment and disposal technology for a Spokane Valley treatment facility which includes anaerobic digestion, vacuum filtration and sanitary landfill. Depending on the timing of implementation and the status of the concurrent City facility, an alternative disposal would be conveyance to the City.

6. Supplement water quality monitoring programs to include bioassays to forecast possible problems at the City STP for unusual stream conditions. Problem examples would be ammonia toxicity, heavy metals and organic compounds.

7. Implement monitoring of the Spokane Valley aquifer to determine the source and long-term consequences of the sudden deterioration of water quality at the Kaiser Eastgate well. Tests should be made to specific levels in the saturated zone of the aquifer and conform to Public Law 93-523 requirements.

8. Institute a wastewater management planning program for the West Plains communities.

9. Implement a management program for septic tank and drainfield operation. This would include mandatory periodic inspection and finding acceptable sites for disposal of septic tank pumpage.

Details on the institutional and financial aspects of implementing the suggested plans are discussed in section VII, Institutional and Financial Implementation of the Suggested Wastewater Management Plan.

Sensitivity Analysis

Wastewater management Plans A and D propose a total treatment and disposal system designed to meet projected year 2000 needs for the City of Spokane, North Spokane and Spokane Valley. The extent to which these facilities as sized will actually meet the needs at year 2000 depends on several factors, including:

1. Population growth for the urbanizing area that is either above or below the projected level considered in this study could result in greater or lesser demands on the treatment systems.

2. A shift in the spatial distribution of population within the urbanizing area, other than as assumed for this study, could result in greater or lesser demands on the treatment systems.

3. Per capita water consumption that is either above or below the level assumed in this study could result in greater or lesser demands on conveyance and treatment systems.

A combination of these factors occurring simultaneously could result in a net increase, decrease or no change over the waste flows projected by this study at each treatment facility.

Figure 14 illustrates the impact of a five and ten percent increase and decrease in projected year 2000 wastewater flows for the treatment plant capabilities detailed in Plans A and D. Applying the criteria and assumptions used in this study, a net change of approximately 27,000 persons would cause a ten percent change in year 2000 projected waste flows for the upgraded City STP. A net change of only about 8000 persons would be necessary to effect a ten percent change in year 2000 projected waste flows for the Spokane Valley treatment plant. Corresponding increases or decreases in waste flow quantity and quality will

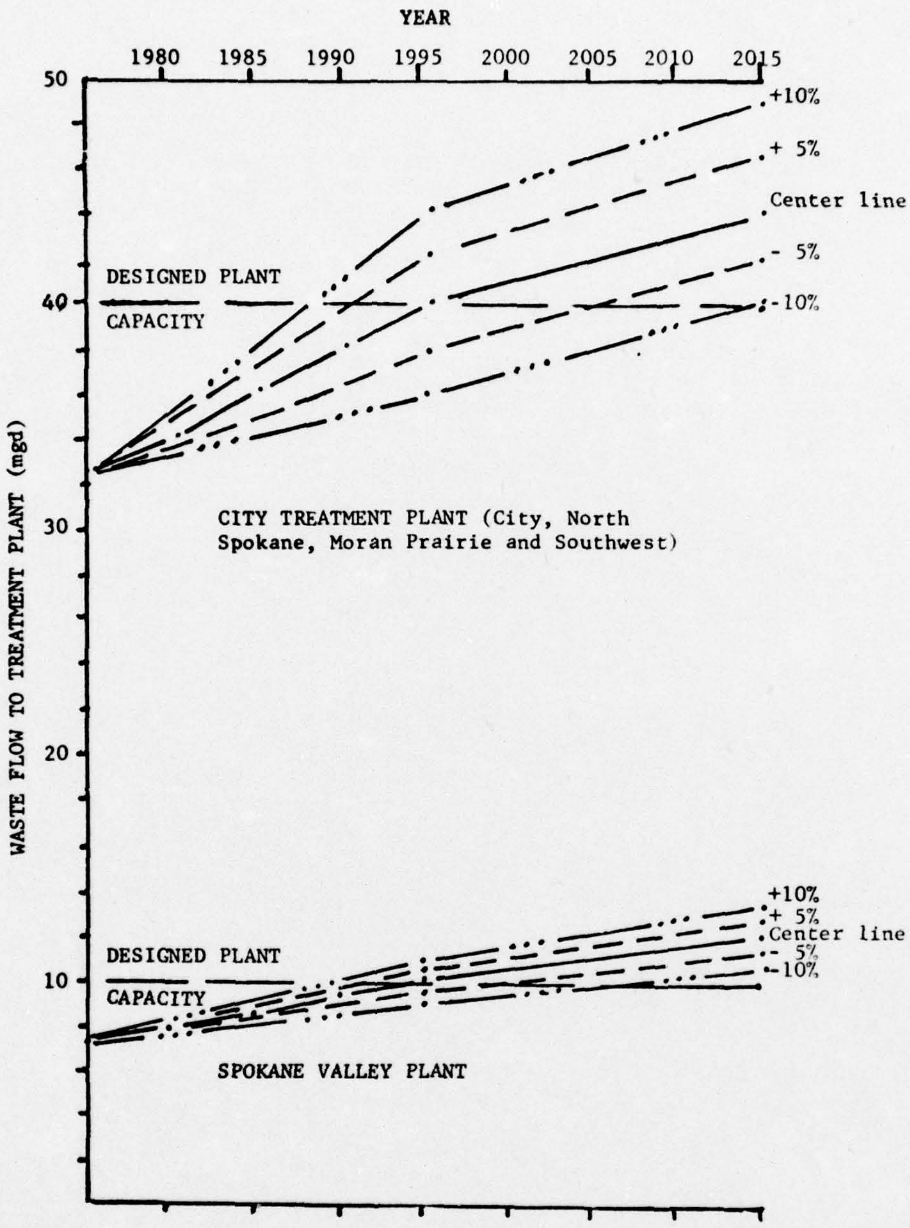


FIGURE 14

SENSITIVITY OF PROJECTED WASTEWATER FLOWS

have minor impact on treatment plant efficiencies. The activated sludge treatment process suggested in this study provides a high degree of treatment. Load variations of plus and minus 10 percent of design load will affect treatment efficiency in the order of ± 2 percent. A loss of 2 percent in treatment efficiency will not be detectable in receiving bodies and will still satisfy secondary treatment criteria.

SECTION VII

INSTITUTIONAL AND FINANCIAL IMPLEMENTATION OF SELECTED WASTEWATER MANAGEMENT PLAN

VII. Institutional and Financial Implementation of Selected Wastewater Management Plan

Evaluation of Existing Institutional Capability

A canvas of Washington State statutes indicated six agency types that have varying sewerage powers, from which the following five alternatives were screened for further consideration in this study:

1. Metropolitan municipal corporation
2. County
3. City
4. Sewerage district
5. Inter-local cooperation contracts between combinations of the above (Co-op)

Cities, counties and metropolitan municipal corporations may finance sewerage projects with general obligation bond issues of up to 5 percent of true value or 10 percent of assessed value of local properties. They are, moreover, all authorized to finance with revenue and local assessment bonds. Sewerage districts also have considerable operational and financing powers and may be desirable servicing agencies for economic or administration reasons.

Suggested Institutional Plan

The suggested institutional plan is illustrated in figure 15. It includes the City-North Spokane subsystem and the Spokane Valley subsystem. The City-North Spokane plan can be summarized as follows:

1. The City would continue to operate its own sewerage facilities, including the treatment plant, the collection system and customer services inside city limits.

2. In areas outside the City, the County, after adoption of the sewerage general plan, would serve as the master sewerage agency, would construct and operate conveyance facilities, and would contract with the City for treatment services and for joint operation and construction of certain mutually used conveyance facilities.

Sewerage Functions	Service Area: City of Spokane - No. Spokane	Service Area: Spokane Valley
Lead Planning Agency	City of Spokane	Spokane County
Treatment & Disposal	City of Spokane	Spokane County
Interceptor System O&M	City of Spokane, Spokane Co.	Spokane County
Collection System O&M	City, County, Local Agencies	County, Local Agencies
Customer Contact	City, County, Local Agencies	County, Local Agencies

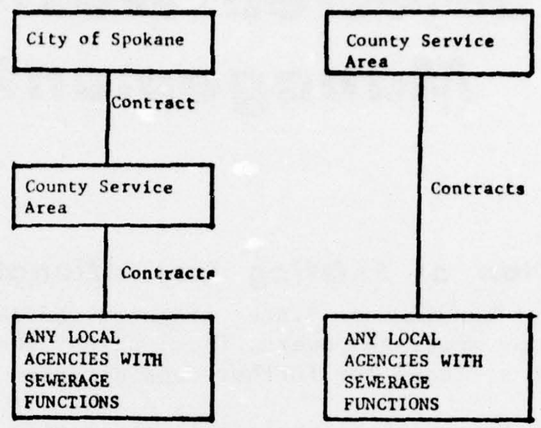


FIGURE 15

INSTITUTIONAL CONFIGURATION FOR URBAN PLANNING AREA

3. Local improvement districts (sewerage) would be formed in county areas to construct and maintain collection systems.

4. In the event that an area provided sewerage service by the County is annexed to the City, then the sewerage functions would transfer to the City in accordance with RCW 36.94.180.

The plan for the Spokane Valley subsystem is as follows:

1. The County, after adoption of the sewerage general plan, would serve as the sewerage program management agency.

2. The County would construct and operate the treatment facilities, disposal facilities and truck sewers.

3. Local improvement districts would be formed to construct and maintain the collection system.

4. In areas where local agencies provide some level of sewerage service, such as the Town of Millwood, the County would obtain written approval to manage the regional sewerage program as allowed by RCW 36.94.040.

Suggested Financial Plan

Two basic approaches were considered for allocating costs where facilities are shared by service elements belonging to different agencies. One is to allocate costs in proportion to amounts of capacity used or reserved. The other method is to have all parties pay equal amounts for equal services. These are commonly referred to as "capacity share" and "equalization" methods, respectively.

For the joint City-North Spokane facilities proposed as part of Plan A, the equalization method is suggested. A detailed analysis using both methods indicated "equalization" to be the most equitable in this particular case.

Table 10 demonstrates that by using equalized costs the 1980 service charge, de-escalated to 1974 price levels, would be $4.12 monthly for City residents, decreasing to $3.75 per month by year 2000. Table 11 indicates that de-escalated service charges for comparable years in North Spokane (County) would be $4.33 and $3.85, respectively. For Spokane Valley residents, table 12 notes that 1985 service charges, de-escalated to 1974 price levels, would be $7.00 decreasing to $4.86 by year 2000. The above monthly service charges do not include costs of internal sewerage or individual hookup to the sewer system.

TABLE 10

CITY REVENUES AND EXPENSES (EQUALIZED COSTS)
CITY AND NORTH SPOKANE SUBAREA - PLAN A

	Year				
	1980	1985	1990	1995	2000
Number of Connections (EDU's)	67,695	68,466	70,539	71,797	73,154
New EDU's Annual	155	415	250	270	230
Service Charge (Monthly)					
Subareawide	$4.40	$5.50	$7.75	$9.35	$11.60
Local	1.66	2.55	3.67	4.71	6.10
Connection Charge (Internal)[1]	$2,305	$3,315	$4,760	$6,820	$9,800
Service Charge-De-Escalated	$4.12	$4.09	$4.33	$3.98	$3.75
Revenues					
Subareawide Service Charges	$3,574,000	$4,519,000	$ 6,560,000	$ 8,056,000	$10,183,000
Local Sewerage Service Charges	1,348,000	2,095,000	3,107,000	4,058,000	5,355,000
Equalization Compensation	478,000	425,000	372,000	319,000	266,000
Total Revenues	$5,400,000	$7,039,000	$10,039,000	$12,433,000	$15,804,000
Expenses					
Subarea Expenses	$3,574,000	$4,519,000	$ 6,560,000	$ 8,056,000	$10,183,000
Internal Sewerage O & M	719,000	710,000	964,000	1,309,000	1,787,000
Customer Service	837,000	1,136,000	1,542,000	2,095,000	2,859,000
Present Bond Service	72,000	--	--	--	--
Bonds For Sewer Corrections	193,000	673,000	970,000	970,000	970,000
Total Expenses	$5,395,000	$7,038,000	$10,036,000	$12,430,000	$15,799,000

[1] **Represents the level of charge to finance local benefit improvements. The revenue from this charge is not shown on this table.**

TABLE 11

NORTH SPOKANE (COUNTY) REVENUES AND EXPENSES (EQUALIZED COSTS)
CITY AND NORTH SPOKANE SUBSYSTEM - PLAN A

	Year				
	1980	1985	1990	1995	2000
Number of Connections (EDU's)	5,645	6,409	8,606	10,528	13,101
New EDU's Annual	120	360	325	430	370
Service Charge (Monthly)					
Subareawide	$4.40	$5.50	$7.75	$9.35	$11.60
Local	1.97	2.53	2.85	4.98	6.57
Connection Charge (Internal)[1]	$1,610	$2,315	$3,325	$4,765	$6,845
Service Charge - De-Escalated	$4.33	$4.08	$4.02	$4.06	$3.85
Revenues					
Subareawide Service Charges	$298,000	$423,000	$ 800,000	$1,181,000	$1,824,000
Local Sewerage Service Charges	133,000	195,000	294,000	629,000	1,033,000
Equalization Compensation	--	--	--	--	--
Total Revenues	$431,000	$618,000	$1,094,000	$1,810,000	$2,857,000
Expenses					
Subarea Expenses	$298,000	$423,000	$ 800,000	$1,181,000	$1,824,000
Internal Sewerage O & M	47,000	69,000	104,000	222,000	365,000
Customer Service	86,000	125,000	190,000	406,000	667,000
Total Expenses	$431,000	$617,000	$1,094,000	$1,809,000	$2,856,000

[1]Represents the level of charge to finance local benefit improvements. The revenue from this charge is not shown on this table.

TABLE 12

REVENUES AND EXPENSES
SPOKANE VALLEY SUBSYSTEM - PLAN A

	Year				
	1980	1985	1990	1995	2000
Number of Connections (EDU's)	20,020	22,130	24,215	26,510	28,390
New EDU's (Annual)	420	420	460	380	380
Service Charge (Monthly)	--	$13.80	$15.65	$18.60	$22.95
Connection Charge (Regional)	--	$450	$650	$935	$1,340
Connection Charge (Internal)[1]	--	$3,425	$4,915	$7,040	$10,120
Service Charge De-Escalated	--	$7.00	$5.93	$5.27	$4.86
Revenues					
Service Charge	--	$3,665,000	$4,548,000	$5,917,000	$7,818,000
Connection Charge (Regional)	--	189,000	299,000	355,000	509,000
Total Revenues	--	$3,854,000	$4,847,000	$6,272,000	$8,328,000
Expenses					
Treatment Plant and Outfall O&M	--	$1,314,000	$1,827,000	$2,517,000	$3,597,000
Internal Sewerage O&M	--	165,000	246,000	371,000	604,000
Customer Service	--	301,000	446,000	678,000	1,104,000
Equalization Compensation	--	900	800	700	600
Bond Service	--	2,062,000	2,313,000	2,698,000	3,013,000
Total Expenses	--	$3,842,900	$4,832,800	$6,264,700	$8,318,600

[1]Represents the level of charge to finance local benefit improvements. The revenue from this charge is not shown on this table.

Upgrading to Plan D facilities is calculated to result in no change to service charges in the City-North Spokane service unit, while for the Spokane Valley service unit an increase in service charges of approximately 20 percent is anticipated.

Implementation Schedule

An implementation schedule for the City-North Spokane portion of Plan A is shown in table 13. There is an adopted County plan for the North Spokane area so that a decision to begin implementation can be made at any time. The schedule indicates completion of first stage construction in 1980.

TABLE 13

IMPLEMENTATION SCHEDULE FOR
THE CITY-NORTH SPOKANE SUBSYSTEM

Date	Action
	Decision to begin implementation.
1 May 1976	Formalize basis for institutional arrangements.
1 Jun 1976	Make initial grant application.
1 Jul 1976	Award engineering contract and begin predesign engineering.
1 Jan 1977	Begin final design, acquire lands and rights-of-way.
1 Feb 1978	Complete plans and specs. and receive grant o'kays.
1 Mar 1978	Advertise for bids
1 Apr 1978	Receive bids.
1 May 1978	Award construction contracts.
1 Jun 1978	Start construction of conveyance system, trunks and collection system.
1 Jun 1980	All conveyance from North Spokane to City STP complete and 70 percent of trunks and collection system complete.
1 Jul 1980	Divert Lidgerwood and Fairwood systems into completed trunk and conveyance system to begin delivery of raw sewage to City STP. Begin transferring individuals from septic tanks to collection system.
31 Oct 1980	Seventy percent of individuals transferred from septic tank disposal to collection system.
30 Jun 1981	Last individual transferred from septic tank disposal to collection system.

There is not an adopted County plan for Spokane Valley area as required by RCW 36.94.030. Due to the uncertainties of decision and timing regarding Spokane Valley, an arbitrary but more distant starting date is selected for the implementation schedule. The selected date of decision is selected for the implementation schedule. The selected date of decision is 1980 leading to completion of first stage construction in 1985. Table 14 shows an implementation schedule for Spokane Valley based on these assumptions.

TABLE 14

IMPLEMENTATION SCHEDULE
FOR THE SPOKANE VALLEY SUBSYSTEM

Date	Action
1 Jan 1980	Adopt County plan and make decision to begin implementation.
1 May 1980	Formalize institutional arrangements.
1 Jun 1980	Make initial grant application.
1 Jul 1980	Award engineering contract and begin predesign engineering.
1 Jan 1981	Begin final design engineering, acquire lands and rights-of-way.
1 Oct 1981	Complete first increment of construction plans.
1 Mar 1982	Complete last increment of construction plans.[1]
1 Apr 1982	Advertise for bids for last increment of construction.
1 May 1982	Receive bids for last increment of construction.
1 Jun 1982	Award contract for last increment of construction.
1 Jul 1982	Start construction for last increment of construction.
1 Mar 1984	All construction completed except individual house connections.
1 Apr 1984	Begin making individual house connections and begin treatment plant operation.
1 Nov 1985	Make last individual house connection.
1 Jul 1995	Possible connection of Liberty Lake to the system.

[1] Early increment of construction plans are advertised, awarded and under construction concurrent with continuing completion of subsequent increments of construction plans.

SECTION VIII

FLOOD DAMAGE PREVENTION

VIII. Flood Damage Prevention

Overview

Minor flooding occurs in the metropolitan Spokane area at three sites along the Spokane River and at one site along lower Hangman Creek. A rural area along the Little Spokane River regularly experiences inundation, but with negligible damage as the area is largely underdeveloped at this time. Figure 16 provides the general location of the areas subject to flooding. The flooding that occurs affects very small areas with low levels of damage and practically no threat to life. None of the existing or potential flood control problems impact on the suggested wastewater or sludge management plans. The existing Spokane sewage treatment plant site and the potential site area for a Spokane Valley treatment plant are above the 100-year flood plain and are not subjected to local drainage problems.

The following table summarizes the approximate extent of property subject to flood damages in a 100-year flood in metropolitan Spokane area.

Location	Structure Involved	Developed Area Involved Acres	Maximum Depth, Ft.
Peaceful Valley	20 residences, 1 industry	11.7	4
Riverpoint	4 industrial/1 post office	8.0	3
Upriver Drive	2 apartments, 1 residence	-	4
Hangman Creek	Up to 5 residences and farm buildings, a trailer court	-	-

The nature of the flood problems in the Spokane urban area does not call for or justify major structural flood damage prevention measures. Small scale local improvements or non-structural approaches are the most appropriate for abatement of flood damage.

Outside of the metropolitan Spokane area, Hangman Creek flooding has caused minor damage to buildings in Tekoa and to roads and agricultural lands. Hangman Creek high flows and flooding causes bank and field erosion, contributing to the heavy silt load downstream. Rock Creek, a tributary of Hangman Creek, periodically floods an area in the town of Rockford, Washington, by overflowing or flowing around an existing inadequate levee.

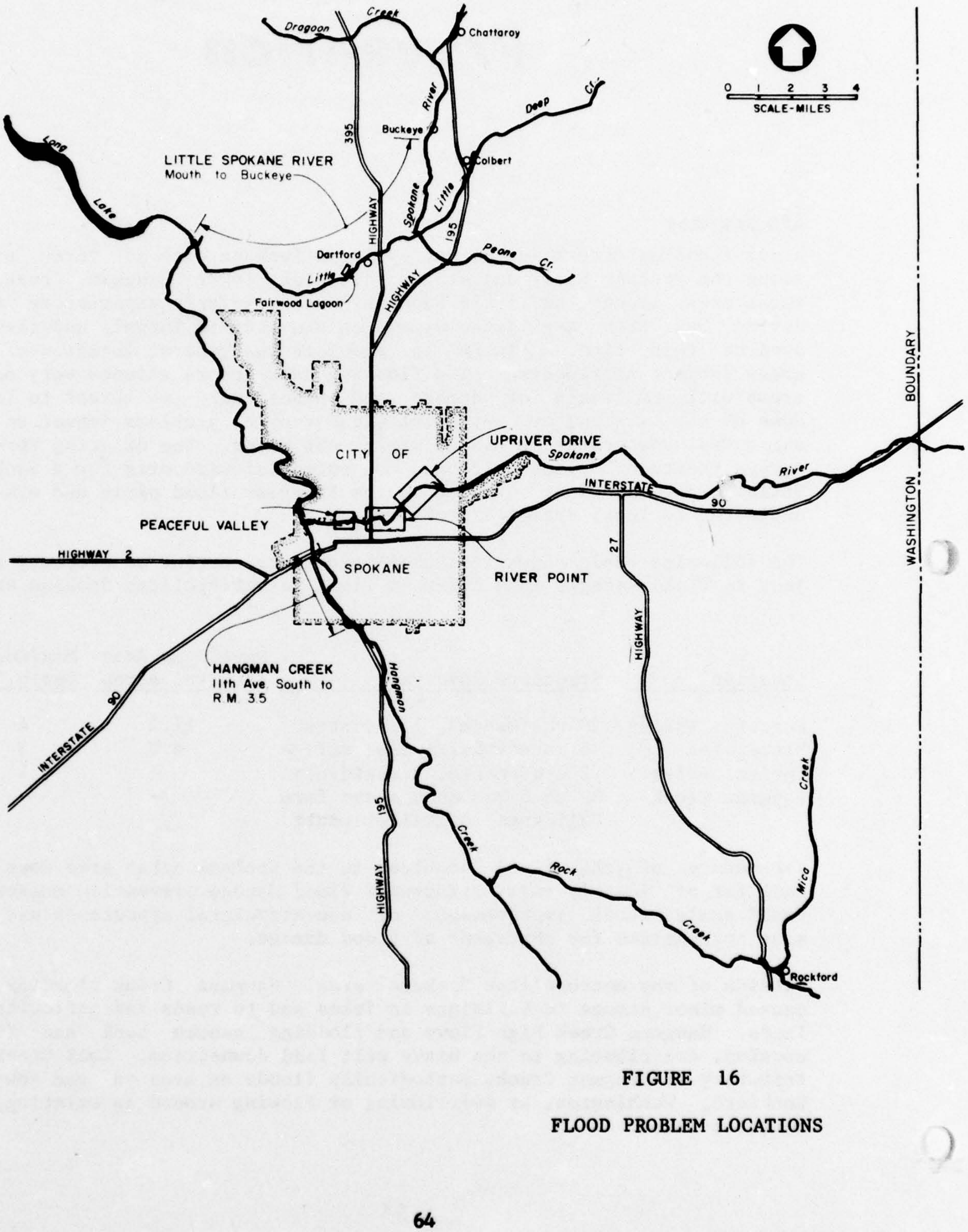


FIGURE 16

FLOOD PROBLEM LOCATIONS

Details of flood problems and needs, and flood damage prevention suggestions, contained in attachment I, are summarized below.

Flood Damage Prevention Suggestions

Identification of flood problem areas, development of flood damage prevention alternatives and selection of best alternatives was accomplished in cooperation with SPRIBCO and CITCOM. The flood problem areas, flood damage prevention alternatives, evaluations and suggested actions are summarized in table 15.

TABLE 15

FLOOD DAMAGE PREVENTION ALTERNATIVES

Alternatives	Spokane River: Pleasant Valley	Spokane River: Riverpoint	Spokane River: Upriver Drive	Little Spokane	Hangman Creek	Rock Creek (Rockford)
Structural						
Dams	NFE	NFE	NFE	NFE	NFE	NFE
Channel Improvement	NFE	NFE	NFE	NFE	NFE	NFE
Levees and Walls	NCE,2	NFE	NCE,2	UNP	NCE	NCE
Bank Protection	NA	NA	NA	NA	NCE,NA	NA
Flood Proofing	MR,1	MR,1	MR,1	MR,1	MR,1	MR,1
Relocation of Structures	NCE	NCE	1	NCE	2	NCE
Non-Structural						
Flood Insurance	MR,2	MR,2	MR,2	MR,2	MR,2	MR,2
Land Use Control	MR,2	MR,1	MR,1	MR,1	MR,1	MR,1
Public Acquisition	2	2	NS	NS	NS	NS
Warning and Emergency Measures	2	2	2	NA	2	2
Land Treatment	NFE	NFE	NFE	NFE	NFE	NFE
No Action	2	2	2	2	2	
Other		1*				

1 = Primary suggestion
2 = Secondary suggestion
NS = Not suggested
UNP = Unacceptable to Public
NA = Not applicable
NFE = Not Functionally Effective
NCE = Not Cost-Effective
MR = Mandatory Regulation per NFIP
* = Fill to protect post office access and to raise Springfield Avenue

Flood damage reduction suggestions are discussed in the following paragraphs.

Spokane River. The suggested flood damage prevention plan for Peaceful Valley is to institute flood proofing measures and to continue reliance on early warning and emergency flood prevention measures. Redevelopment should remain a long range flood damage prevention objective.

At the Riverpoint location, considering the riverfront by sections from west to east, suggested actions are as follows:

1. No action is suggested for the section between Lake Arthur and the river east to the railroad embankment as there is no development subject to damage. If an element of the City's projected plans for a waterfront park is developed here, the road between Lake Arthur and the river could be build above flood level but with culverts to allow flooding through so that the road would not have to function as a structural levee.

2. From the railroad embankment to the West Trent Bridge, it is suggested that some filling be done on the southwest and northwest side of the post office to protect continuous access to this important facility. A more permanent solution can await riverfront development to open space. In the meantime, development in the large area northwest of the post office should not be permitted without prior solution of the flooding problem.

3. From the West Trent Bridge to the East Trent Bridge it is suggested that no action be taken other than to prohibit development in the railroad property subject to flooding.

4. Prohibition of additional development from the East Trent Bridge to the railroad is suggested. The flooding of Springfield Avenue by waters entering the east end of the street should be investigated for possible improvement west of Columbus Street by raising the street grade to provide a dry approach to the post office. Consideration should be given by the City to acquisition of the other presently vacant parcels along this reach with later acquisition of a lot on the east side of Superior Street. With the full width of the lots to work on it may be possible to construct a broad fill which would serve as a levee on the unsatisfactory foundation material.

A combination of alternatives is suggested for River Point, including no action and fill to raise the road for access to the post office. In addition, future development which would be damaged by flooding should be prohibited.

The primary suggestion for the Upriver Drive area east of the Washington Water Power building is the prevention of further development on sites subject to flooding pending solution of the flooding problem. Reconstruction of Upriver Drive at a grade above flood plain cannot be suggested on a cost-benefit basis. It is suggested that the City make a policy decision as to whether they plan to modify the grade of Upriver Drive for any reason, such as upgrading to parkway status. If this is not imminent, the individual home owner should be encouraged to raise and/or move back his home and the apartment owners to proceed with flood proofing. Land use and/or building restrictions should be instituted to prevent further development within the flood plain.

One of the non-structural alternatives to reduction of the impact of flood damage is a flood insurance program. Such a program has been made available nationally through the National Flood Insurance Program (NFIP) under the Flood Insurance Administration (FIA) of the U.S. Department of Housing and Urban Development (HUD).

Both the City and County have established eligibility under NFIP and are therefore committed to establish acceptable flood plain management measures. Communities within the study area with identified flood hazard areas which have not established NFIP eligibility are Fairfield, Latah, Rockford, Tekoa and Waverly.

The Corps of Engineers is currently conducting a flood insurance study for the City at the request of HUD. The study includes the Spokane River from the upstream city limits at Felts Field downstream to Riverside Park near Veterans Hospital. The flood plain information gathered in this study will be used in the flood insurance study.

The mandatory requirements of NFIP, such as flood proofing and flood plain management, when implemented, will in effect fulfill many of the flood damage prevention suggestions provided in this report.

<u>Little Spokane River</u>. Structural measures along the Little Spokane River are not recommended. It is suggested that flood damage prevention consist of education and control against encroachment on the high-flow channel by incompatible development. Existing "flood prone" structures should be relocated or flood proofed.

<u>Hangman Creek</u>. Non-structural flood control measures must be relied on to control and limit the possible increase of flood damage on Hangman Creek. Relatively few residences are involved in Hangman Creek flooding problems as the threatened areas are presently at low density in semi-rural development. The National Flood Insurance Program will require regulatory land use control, therefore damage exposure will be prevented from increasing. It is suggested that the areas threatened by flood damage be defined to include not only those areas subject to inundation, but also those areas that are threatened by erosion.

The Corps of Engineers is also currently conducting a flood insurance study along Hangman Creek for the City at the request of HUD. The

study includes the reach from the confluence with the Spokane River to 7.4 miles upstream (approximately 3 miles upstream of the Spokane city limits.)

Rock Creek. Non-structural flood control measures to prohibit further development within the flood plain are suggested and flood proofing of existing structures is encouraged in accordance with NFIP requirements.

Institutional and Financial Considerations

Institutional needs relative to flood control in the Spokane area fall into three categories: (1) those related to making planning decisions, (2) those related to enforcing non-structural alternatives such as zoning and (3) those related to providing financing for acquisition or structural alternatives. Both the City and County have all the required powers to fulfill all three needs and further are the only agencies empowered to fulfill the first two needs. The only area in which institutional alternatives require consideration is in support of financing. The alternative institutions which can function under the City or County are as follows:

1. Diking District
2. Drainage District
3. Diking, Drainage and Sewerage Improvement District
4. Flood Control District
5. Flood Control Zone District

Institutions 1, 2 and 3 above can provide funding only through special district assessments. The City and County can also provide this kind of funding through formation of local improvement districts and therefore the first three institutions which were provided by early legislation are essentially obsolete. Flood Control Districts can, in addition to special assessments, provide funding through general obligation bonds. A Flood Control Zone District (FCZD) has all the financing powers of the County, including service charges and some planning and regulatory powers.

The primary reason for consideration of an FCZD is to provide coordination of a flood control effort extending through several county and municipal jurisdictions. The particular flood control problems and their feasible solutions in the Spokane area are limited in extent and occur within City or County jurisdiction. Therefore there is no advantage to consideration of an FCZD. The formation of Local Improvement Districts is suggested as the most feasible means to fulfill the three categories above.

SECTION IX

URBAN RUNOFF MANAGEMENT

IX. Urban Runoff Management

Introduction

Extensive stormwater collection and disposal facilities within the metropolitan study area are generally limited to the City of Spokane. Urban runoff from man-made impervious areas within the City is discharged into the Spokane River through a system of sewers incorporating combined (stormwater with sanitary sewer flows) and separate storm sewers. The needs associated with this runoff include; (1) pollution abatement and (2) flow control. Existing flow conveyances become overloaded during high runoff periods, causing either excessive demands on the sewage treatment plant or overflow of both storm and sanitary sewers to the river.

The North Spokane suburban area contains a limited storm drainage system that includes both sewers and roadside ditches. The ultimate point of discharge is the Little Spokane River. There are no combined sewers in the North Spokane suburban area. The area in general slopes directly toward the Little Spokane River. The major problem in North Spokane centers around the Country Homes area.

The Spokane Valley area contains practically no storm drainage systems. All drainage is essentially by percolation, either from "dry wells" dug for this purpose or by simple infiltration at the ground surface. The ground surface slopes to the Spokane River, which would be the recipient of any collected storm drainage. However, the drainage configuration in general consists of swales parallel to the river and separated from the river by low ridges so that any collection system would require an extensive trunk system. Major problem locations noted for Spokane Valley include the Pasadena Park area, Bennen Road area in Trentwood and Chester (Plouf) Creek area.

As development increases, the capacity of the natural system tends to decrease. Problems are further compounded by the increased runoff load created by additional impervious surface.

Urban Runoff Plan Development

The primary unmet need to be addressed in urban runoff management planning for the metropolitan area is the serious consequence of overflow from combined sewers. To this end the City of Spokane has already

initiated a planning program. The City will select and implement remedial measures which will either eliminate the combined sanitary storm sewer system or will provide treatment for the mixed sanitary and storm waters to minimize the impact of the sanitary component on the receiving waters. The City Plan of Study is not intended to address treatment of separate urban runoff. Urban runoff would be treated only as incidental to treatment of sanitary wastes in combined flows. As of this date, EPA has not established criteria for any level of treatment for separated urban runoff and the City is not under directive to abate pollution due to separate urban runoff.

Possible plans being considered by the City were evaluated and it was determined that the most severe impact on receiving water quality would be discharge of separate untreated storm flows during the summer low flow period. The study is directed toward forecasting the separate storm water pollution load and evaluating its impact.

Development of Urban Runoff Water Quality Impact

Standards for evaluating the water quality impact of urban runoff were assumed. The Technical Report includes details of all criteria developed regarding urban runoff for establishing basic and forecast flows and pollutant loads; acceptable water quality impact; and associated evaluation factors.

Evaluation of Urban Runoff Water Quality Impact

The evaluating of urban runoff water quality impact is based on urban runoff flows and pollution load forecasts associated with the year 2020 development conditions. Flows have been derived for each of the three basic planning areas for annual and summer season conditions using a 24-hour storm event of 2-year return frequency. The forecast pollutant loads have been developed for these areas for annual, summer season, 24-hour 2-year return and average typical events as indicated in table 16.

One basis for evaluation of the impact of urban runoff pollution load is a direct comparison with the corresponding sanitary pollution load from the same area. These data are also provided in table 16 for the forecast treated sanitary effluent assuming 1983 effluent standards for activated sludge secondary treatment plus seasonal phosphorous removal.

In order to evaluate the impact of urban runoff on the water quality of receiving waters, it is necessary to present the background water quality summarized in table 17. Tables 18, 19, 20 and 21 provide urban runoff pollution evaluation for the City of Spokane, North Spokane and Spokane Valley service areas and all service areas combined.

TABLE 16

FORECAST URBAN RUNOFF AND TREATED SANITARY EFFLUENT, YEAR 2020

	CITY OF SPOKANE				NORTH SPOKANE				SPOKANE VALLEY			
	Annual	Summer Season (2)	24hr-2yr Event (3)	Typ Sum. Event (4)	Annual	Summer Season (2)	24hr-2yr Event (3)	Typ Sum. Event (4)	Annual	Summer Season (2)	24hr-2yr Event (3)	Typ Sum. Event (4)
URBAN RUNOFF												
Volume, Acre Feet (1)	6,943	1,389	404	134	1,618	324	88.9	29.3	2,901	580	158	52.0
Volume, Million Gallons (1)	2,263	453	132	44	527	106	29.0	9.6	946	189	51.4	17.0
BOD, Range (5)												
Max 10^3 Pounds	588	176	41.5	16.6	129	38.8	9.05	3.62	230	69.0	16.1	6.44
Min 10^3 Pounds	294	88	20.8	8.3	64.7	19.4	4.53	1.81	115	34.5	8.05	3.22
Midrange conc. mg/l	23.4	35.0	28.3	34.0	22.1	33.0	28.1	34.0	21.9	32.9	28.2	34.1
Total N, Range (5)												
Max 10^3 Pounds	83.6	22.2	5.55	2.22	18.4	4.90	1.20	.48	32.8	8.72	2.20	.88
Min 10^3 Pounds	41.8	11.1	2.78	1.11	9.21	2.45	.60	.24	16.4	4.36	1.10	.44
Midrange conc. mg/l	3.3	4.4	3.8	4.5	3.1	4.2	3.7	4.5	3.1	4.2	3.9	4.7
Total P Range (5)												
Max 10^3 Pounds	61.6	17.0	12.6	5.03	13.5	3.72	2.77	1.11	24.0	6.64	4.90	1.96
Min 10^3 Pounds	15.4	4.25	3.10	1.24	3.38	0.93	.68	.27	6.01	1.66	1.23	.49
Midrange conc. mg/l	2.0	2.8	7.1	8.6	4.9	2.6	7.1	8.6	1.9	2.6	7.2	8.7
SANITARY EFFLUENT (6)												
Volume, Million Gallons	13,452	4,484	37	9.21	2,904	968	8.0	1.99	4,449	1,483	12.2	3.05
BOD, 10^3 Pounds (7)	2,330	680	5.6	1.4	603	176	1.4	0.35	930	272	2.16	.54
Total N, 10^3 Pounds (7)	1,720	570	4.8	1.2	472	157	1.24	0.31	714	238	1.92	.48
Total P, 10^3 Pounds (7)	520	41	.34	.08	144	11.4	.09	0.022	217	17.2	.13	.033

(1) Runoff volume corresponding to connected impervious area.
(2) June 1 through September 30 during which 20X of annual rainfall occurs and 12 of 49 events occur.
(3) Total event rainfall 1.06 inches, average rate .044 inches/hr.
(4) Total event rainfall 0.35 inches, 13.1 day average between events.
(5) Refer to Table 13-3 for criteria.
(6) Treated effluent to 1983 standards of activated sludge secondary and with seasonal P removal.
(7) Sanitary pollutant quantities are accumulated for periods corresponding to URO periods, respectively: 1 year, 4 months, 1 day and 6 hours.

TABLE 17

BACKGROUND QUALITY OF RECEIVING WATERS

Parameter	Units	Mean Values Jan-Mar	Apr-June	July-Sept	Oct-Dec
Spokane River at Boundary (RM 96.5)					
Temp.	°C	3.2	10.8	19.0	9.1
D.O.	mg/l	12.1	11.4	8.8	10.2
BOD	mg/l	1.1	2.5	1.9	1.0
Tot. PO_4-P	mg/l	0.048	0.130	0.024	0.024
NH_3-N	mg/l	0.037	0.086	0.051	0.019
Tot. N	mg/l	0.25	0.30	0.29	0.21
Tot. Colif.	No./100ml	518	251	1398	684
Zn. Diss.	ug/l	392	318	168	261
Little Spokane at Mouth (RM 1.1)					
Temp.	°C	5.2	12.4	13.5	7.0
D.O.	mg/l	10.5	8.9	8.8	10.5
BOD	mg/l	1.1	0.8	0.5	--
Tot. PO_4-P	mg/l	0.086	0.084	0.039	0.030
NH_3-N	mg/l	0.077	0.042	0.064	0.042
Tot. N	mg/l	1.300	1.105	1.530	1.206
Tot. Colif.	No./100ml	1802	1012	1776	880
Zn. Diss.	ug/l	42	43	4	15
Groundwater, Primary Aquifer		(Mean Values, Year Around)			
Temp.	°C	10.7			
BOD	mg/l	Negligible			
Total P	mg/l	0.014			
NH_3-N	mg/l	0.015			
NO_3-N	mg/l	1.521			
Total N	mg/l	1.649			
Lead	mg/l	0.019			
Tot. Colif.	No./100ml	None			

TABLE 18

URBAN RUNOFF POLLUTION EVALUATION, CITY - YEAR 2020

Urban Runoff Parameter	Annual: Flow - cfs and Average Load-pounds	Annual: Dilution[6] and conc. mg/l[1]	Summer Season: Flow - cfs and Average Load-pounds	Summer Season: Dilution[6] and conc. mg/l[2]	24-Hr 2-Yr Event: Flow - cfs and Average Load-pounds	24-Hr 2-Yr Event: Dilution[6] and conc. mg/l[3]	Typical Event: Flow - cfs and Average Load-pounds	Typical Event: Dilution[6] and conc. mg/l[4]	Typical Event: Dilution[6] and conc. mg/l[3]
Runoff Volume	9.59	.00138	5.75	.00120	204	.10350	269	.2383	.1321
BOD[7]	441,000	.03	132,000	.04	31,150	2.93	12,450	8.1	4.5
Total N[7]	62,700	.005	14,650	.005	4,165	.39	1,665	1.07	.59
Nitrate[8]	-	-	-	-	-	.09	-	.25	.14
Ammonia[9]	-	-	-	-	-	.05	-	.13	.07
Total N[7]	38,500	.003	10,625	.003	7,850	.73	3,135	2.05	1.14
Total Coliform[5]	1	1	-	-	-	10,000	-	24,000	13,000
Lead[10]		.0004		.0004		.03		.07	.04

[1] In mean annual flow of Spokane River per Spokane gage - 6927 cfs.
[2] In mean flow for the summer season, June 1 through September 30 per Spokane gage 4770 cfs.
[3] In mean flow for lowest month of the summer season, September at 1767 cfs per Spokane gage.
[4] In 10-year 7-day low flow of Spokane River at Spokane of 860 cfs.
[5] Based on average conc. in urban runoff of 100,000 org/ml.
[6] Dilution factor = $\frac{\text{URO}}{\text{URO and Receiving Stream}}$
[7] Midrange values from Table 16.
[8] At 23% of Total N per Seattle data.
[9] At 12% of Total N per Seattle data.
[10] Based on average conc. 0.30 mg/l per Seattle data.

TABLE 19

URBAN RUNOFF POLLUTION EVALUATION, NORTH SPOKANE - YEAR 2020

Urban Runoff Parameter	Annual: Flow - cfs and Average Load-pounds	Annual: Dilution[6] and conc. mg/l[1]	Summer Season: Flow - cfs and Average Load-pounds	Summer Season: Dilution[6] and conc. mg/l[2]	24-Hr 2-Yr Event: Flow - cfs and Average Load-pounds	24-Hr 2-Yr Event: Dilution[6] and conc. mg/l[3]	Typical Event: Flow - cfs and Average Load-pounds	Typical Event: Dilution[6] and conc. mg/l[4]	Typical Event: Dilution[6] and conc. mg/l[3]
Runoff Volume	2.23	.0043	1.34	.00351	44.76	.118	59.01	.168	.1505
BOD[7]	96,850	.09	29,100	.11	6,790	3.32	2,715	5.71	5.11
Total N[7]	13,805	.01	3,675	.015	900	.44	360	.76	.68
Nitrate[8]	-	-	-	-	-	.10	-	.17	.15
Ammonia[9]	-	-	-	-	-	.05	-	.09	.00
Total P[7]	8,440	.006	2,325	.01	1,725	.84	690	1.44	1.29
Total Coliform[5]	-	-	-	-	-	12,000	-	17,000	13,000
Lead[10]	-	.001	-	.001	-	.036	-	.05	.045

[1] In mean annual flow of Little Spokane River per Dartford gage - 316 cfs + 200 cfs groundwater intrusion = 516 cfs.
[2] In mean flow for the summer season, June 1 through September 30 of LSR per Dartford gage - 180 cfs + 200 cfs groundwater intrusion = 380 cfs + URO.
[3] In mean monthly flow for lowest month of the summer season, August 136 cfs + URO + 200 cfs groundwater intrusion = 336 cfs + URO.
[4] In 10-year 7-day low flow of LSR per Dartford gage - 92 cfs + URO + 200 cfs groundwater intrusion = 292 cfs + URO.
[5] Based on average conc. in urban runoff of 10^5 org/100 ml.
[6] Dilution factor = URO mean flow/(receiving water mean flow and URO).
[7] Midrange values from Table 16.
[8] At 23% of total N per Seattle data.
[9] At 12% of total N per Seattle data.
[10] Based on average conc. of 0.30 mg/l from Seattle data.

TABLE 20

URBAN RUNOFF POLLUTION EVALUATION, SPOKANE VALLEY - YEAR 2020

	Annual		Summer Season		24-Hr 2-Yr Event		Typical Event		
Urban Runoff Parameter	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[1]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[2]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[3]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[4]	Dilution[6] and conc. mg/l[3]
Runoff Volume	4.01	.00058	2.4	.0005	79.5	.0431	105.2	.109	.056
BOD[7]	172,500	.013	51,750	.016	12,080	1.22	4,830	3.72	1.92
Total N[7]	24,600	.0018	6,540	.0021	1,650	.17	660	.51	.26
Nitrate[8]	-	-	-	-	-	.04	-	.12	.06
Ammonia[9]	-	-	-	-	-	.02	-	.06	.03
Total P[7]	15,000	.0011	4,150	.0013	3,065	.31	1,225	.95	.49
Total Coliform[5]	-	-	-	-	-	4,000	-	11,000	6,000
Lead[10]	-	.00017	-	.00015	-	.013	-	.033	.017

[1]In mean flow of Spokane River per Spokane gage - 6927 cfs.
[2]In mean flow for the summer season June 1 through September 30 per Spokane gage - 4770 cfs.
[3]In mean flow for the lowest month of the summer season, September at 1767 cfs per Spokane gage.
[4]In 10-year 7-day low flow per Spokane gage at 860 cfs.
[5]Based on average conc. in urban runoff of 10^5 org/100 ml.
[6]Dilution factor = $\frac{\text{URO}}{\text{URO and Receiving Water}}$.
[7]Midrange values from Table 16.
[8]At 23% of total N per Seattle data.
[9]At 12% of total N per Seattle data.
[10]Based on average conc. of 0.30 mg/l per Seattle data.

TABLE 21

URBAN RUNOFF POLLUTION EVALUATION, COMBINED EFFECT ON ALL SERVICE AREAS - YEAR 2020

	Annual		Summer Season		24-Hr 2-Yr Event		Typical Event		
Urban Runoff Parameter	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[1]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[2]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[3]	Flow - cfs and Average Load-pounds	Dilution[6] and conc. mg/l[4]	Dilution[6] and conc. mg/l[3]
Runoff Volume	15.84	.00189	9.51	.00169	328	.1097	437	.2957	.1411
BOD[7]	710,350	.04	212,850	.06	50,015	3.1	19,995	10.1	4.8
Total N[7]	101,105	.006	26,865	.007	6,715	.42	2,685	1.36	.65
Nitrate[8]	-	-	-	-	-	.10	-	.31	.15
Ammonia[9]	-	-	-	-	-	.05	-	.16	.08
Total P[7]	61,945	.004	17,100	.005	12,640	.78	5,050	2.54	1.21
Total Coliform[5]	-	-	-	-	-	11,000	-	30,000	14,000
Lead[10]	-	.0006	-	.0005	-	.033	-	.089	.042

[1]In mean annual flow of Spokane River below LSR confluence per Long Lake gage 8381 cfs.
[2]In mean flow for the summer season June 1 through September 30 per Long Lake gage 5630 cfs.
[3]In mean flow for the lowest month of the summer season, August per Long Lake gage 2661 cfs.
[4]In approximated 10-year 7-day low flow at Long Lake gage 1041 cfs.
[5]Based on average conc. in urban runoff of 10^5 org/100 ml.
[6]Dilution factor = $\frac{\text{URO}}{\text{URO and Receiving Water}}$.
[7]Midrange values from Table 16.
[8]At 23% of Total N per Seattle data.
[9]At 12% of Total N per Seattle data.
[10]Based on average conc. of 0.30 mg/l per Seattle data.

Summary of Urban Runoff Pollution Abatement Unmet Needs

There are no demonstrable absolute needs for abatement of potential pollution from urban runoff sources in the Spokane urban planning area. All apparent needs are conditional, some dependent upon the as yet unestablished short term pollution limits and some dependent upon the synergistic effect of pollutants. The urban runoff phosphorus potential is approximately one-half that from sanitary effluent treated for phosphorus removal. Based on the mathematical simulation of water quality in Long Lake under projected loading conditions and assuming 1983 standards, it is considered that the incremental phosphorus addition to Long Lake represented by untreated urban runoff will not perceptibly influence the level of biomass growth.

The heaviest phosphorous contribution from runoff occurs during the period of higher river flows and lower temperatures when phosphorus concentration is not limiting to biological growth.

Urban runoff reaching surface waters in large quantities will cause short term conditions of total coliform counts that are in excess of Class A stream standards. The public health consequences of these short-term excesses are a function of the specific kind of recreational demands that are being put on the receiving waters at that time. If there is a need to have the receiving water available for unrestricted body contact recreation, such as swimming, at all times, including periods of inclement weather, abatement by disinfection is required. Disinfection by chlorination, however, must be recognized as creating a threat to use of the stream as a fish habitat. The risk in creating excessive chlorine residuals or toxic chlorine compounds is much higher where application is to highly variable uncontrolled urban runoff flows. Although an absolute unqualified need for disinfection cannot be identified, selection of action plans dealing with urban runoff should recognize the potential need by providing a means, such as storage, to make disinfection feasible or to avoid surface water disposal through percolation.

The short-term threat of toxicants to surface water, exemplified by lead, is marginal in an absolute sense when compared with long-term standards.

Urban Runoff Reduction Alternatives

There is not an immediate mandatory need for reduction in pollution due to urban runoff considered alone and not as an element of combined sewer overflow. However, reduction in pollution potential may be

desirable in the future. Some of the more effective techniques for urban runoff pollution control are non-structural or are incidental to good drainage practice. Also, the effectiveness of structural treatment methods, if ever required by future criteria, are in many cases dependent upon conditions built into the collection system. For these reasons the available techniques for reduction of urban runoff pollution were explored with particular attention to non-structural methods and conditions which will facilitate possible future treatment.

Design of drainage facilities should consider the benefit of taking all opportunities to include storage and percolation so that treatment, if necessary, will be feasible.

Urban runoff pollution abatement alternatives are summarized in table 22.

TABLE 22

POLLUTION ABATEMENT ALTERNATIVES
FOR SEPARATED URBAN RUNOFF

Method	Alternative
Non-Structural	1. Land use control
	2. Impervious surface connection regulation
	3. Regulation of construction operations
	4. Litter laws and enforcement
	5. Surface housekeeping (street sweeping, etc.)
	6. Use of unleaded gasoline
Structural	1. In-system storage
	a. Ponding in streets and parking areas
	b. Rooftop ponding
	c. Ponding structures
	d. Oversized conveyance systems
	e. Conveyance system regulating structures
	2. Terminal storage
	3. Groundwater recharge
	4. Treatment, separate
	a. Sedimentation
	b. Skimming
	c. Screening
	d. Flotation
	e. High rate filtration
	f. Microstraining
	g. Chlorination
	5. Treatment with sanitary sewage

Urban Runoff Pollution Abatement Conclusions

The basic conclusion to be derived regarding specific treatment of separate urban runoff to control this vector of water pollution is that it is not justifiable at this time. In addition, the present unsolved technical complexities of providing reliable and significant pollutant removals other than by non-structural methods, storage or percolation are such as to raise serious questions of the wisdom of applying physical or chemical treatment measures. This conclusion suggests that present emphasis should be on source control of urban runoff pollutants, which supports the concept of storm/sanitary sewage separation at the source and suggests that good "houskeeping" appears to be the most cost-effective means of effecting reduction in surface runoff pollutants.

Design of drainage facilities to be accomplished by local interests should consider inclusion of storage and percolation so that treatment, if necessary, will be minimized.

Additional details on urban runoff pollution abatement are discussed in attachment II, Urban Runoff Pollution Abatement.

Urban Runoff Flow Control

City of Spokane Service Area. The City north of the Spokane River has generally adequate natural slope for drainage but no distinct natural system of drainage channels. The existing system of combined sewers generally follows the natural ground slope pattern. Drainage problems within the City exist due to lack of sewer capacity. In some cases deliberate ponding to minimize peak wet weather flows in the combined sewers does occur. South of the Spokane River the drainage pattern is more typical in that there are areas in which there are natural drainage channels. There are also areas of spring outcrops. Here the combined sewer problem is compounded by the presence of infiltration flows, some of which derive from deliberate drainage of springs. The City study program previously cited is directed toward solution of these existing internal flooding problems concurrent with resolution of the combined sewer overflow problem.

North Spokane Service Area. Certain locations in North Spokane currently experience flooding due to a combination of runoff from urban development and runoff from presently undeveloped areas which must pass through developed areas as indicated in figure 17. There is a natural drainage way through the North Spokane development that has been improved as an urban drain. This drainage discharges into the Little Spokane River, but does not serve the entire area. Portions of this developed area suffer from flooding from three causes: (1) encroachment on the restriction of the primary natural drainage path, (2) increase in runoff due to development and (3) local low spots that do not have natural surface drainage.

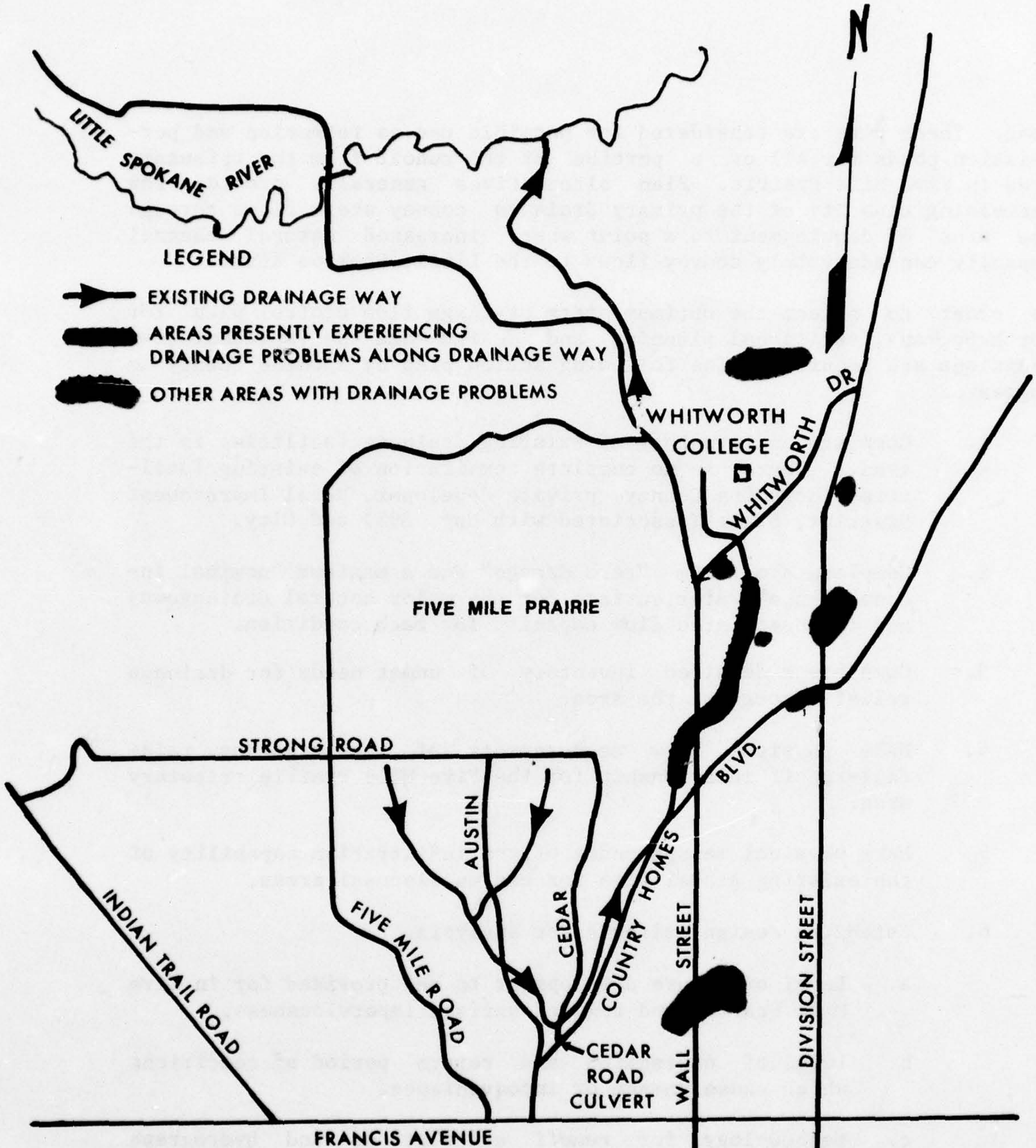


FIGURE 17

NORTH SPOKANE URBAN DRAINAGE PROBLEMS

These drainage problems of the North Spokane area have been the subject of preliminary investigations conducted by the County Engineer's office. The basic drainage problem is that a significant portion of the natural drainageway is on private property. High flows flood adjoining development. Rather than try to increase the capacity of the section through private property, the alternative solutions considered by the County involve methods for diverting sufficient upstream flows to maintain flows which will not cause nuisance or damage. There are no available estimates of historical damage for either the main drainageway or for the local low areas. One of the physical features of the area considered in the County alternatives is the location of the gravel pits northwest of the intersection of Francis Avenue and Cedar

Road. These pits are considered for possible use as retention and percolation ponds for all or a portion of the runoff from the tributary area in Five Mile Prairie. Plan alternatives generally provide for increasing capacity of the primary drain to convey storm flows through the area of development to a point where increased natural channel capacity can adequately convey flows to the Little Spokane River.

In order to select the optimum storm drainage flow control plan for North Spokane, additional planning and design data and implementation decisions are required. The following action plan by Spokane County is suggested:

1. Complete an inventory of existing drainage facilities in the area. There is no complete compilation of existing facilities including County, private developer, Rural Improvement District, State (associated with Hwy. 395) and City.

2. Complete a maximum "zero damage" and a maximum "nominal inconvenience" water surface for the major natural drainageway and the associated flow capacity for each condition.

3. Complete a detailed inventory of unmet needs for drainage relief throughout the area.

4. Make physical flow measurements of the existing rainfall-runoff relationship for the Five Mile Prairie tributary area.

5. Make physical measurements of the infiltration capability of the existing gravel pits for use as disposal areas.

6. Establish design criteria for analysis.

    a. Level of future development to be provided for in Five Mile Prairie and related surface imperviousness.

    b. Level of protection and return period of conditions which cause damage or inconvenience.

    c. Methodology for runoff calculations and hydrograph volumes.

7. Establish a working relationship between City and County for presentation of alternatives to the County Commissioners and City Council.

8. Prepare an overall integrated drainage plan for the entire area before undertaking any piecemeal solutions.

9. The overall drainage plan should consider minimizing the impact of urban drainage on surface water quality. The location of the terminus of the natural drainageway at the Little Spokane River appears to present an opportunity for

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storage in the flood plain which could be utilized to effect economical treatment of bacteriological contamination, the primary concern.

10. The overall drainage plan should consider non-structural alternatives for minimizing increases in runoff from future development by regulation of such development to utilize on-site retention.

Spokane Valley Service Area. At present, with a few minor exceptions, no urban runoff reaches the Spokane River from the existing urban development.

Although there were and are no natural streams on the surface of the Spokane Valley due to the highly permeable soil, the topography has a configuration similar to land shaped by surface runoff, consisting of a system of low ridges and swales paralleling the river and converging on a natural point of concentration in the vicinity of the east end of Felts Field. Therefore, any collection system for urban runoff would necessarily follow these land forms. The potential for flooding due to urban runoff is related to these same land forms. Once the collection process is started, any inadequacies or failures of the system would be concentrated along the bottom of these swales. At present there are no valley floor collection systems, all runoff disposal being to dry wells or surface percolation. In general these facilities presently provide adequate drainage.

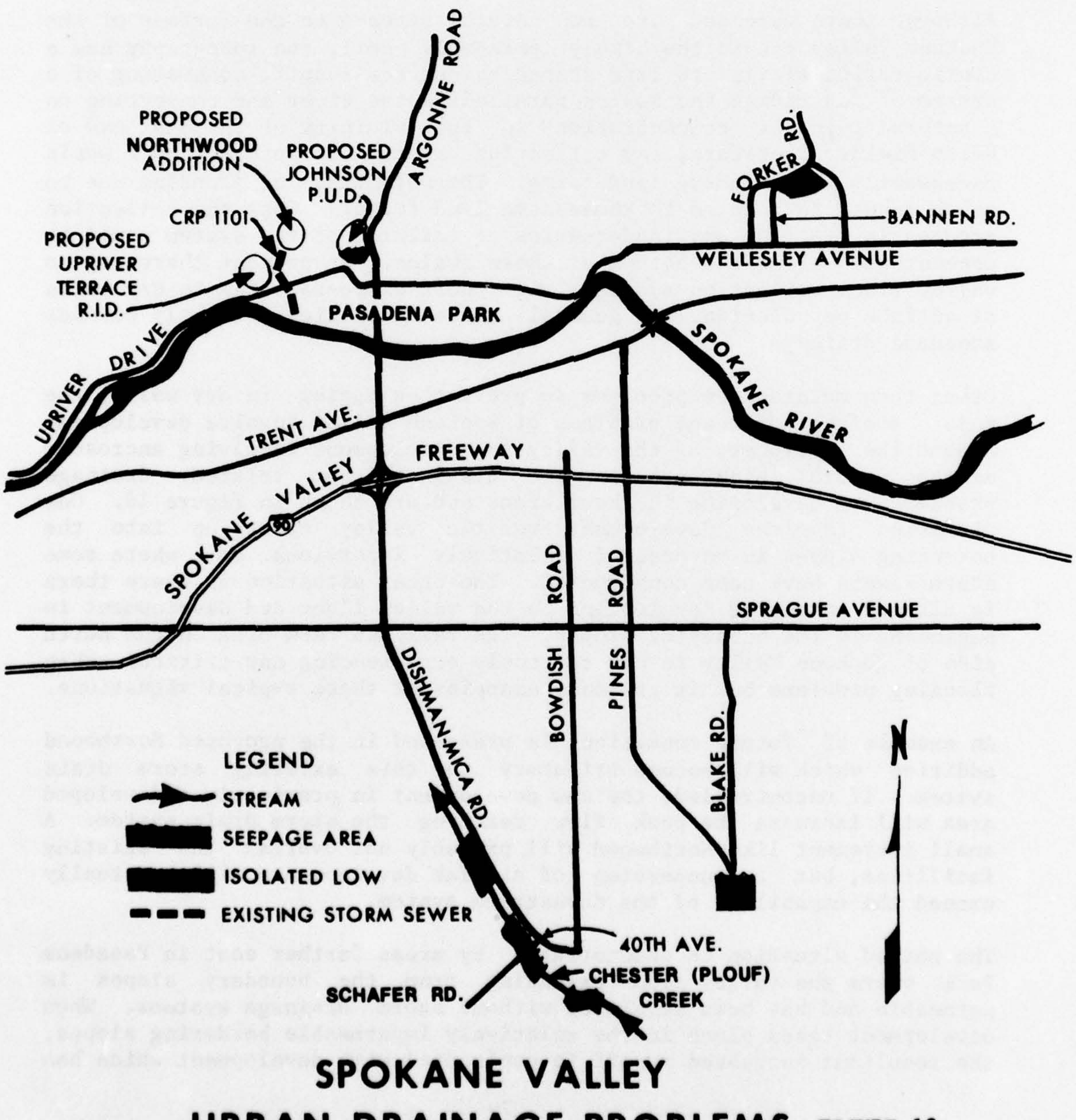
Other than maintenance problems to prevent clogging in dry wells, the major surface drainage problems of Spokane Valley involve development around the periphery of the valley and development involving encroachment on natural sink areas. Two distinct, but related, drainage problems are developing in these areas and are shown in figure 18. One situation involves development from the valley floor up into the bordering slopes in an area of relatively impervious soil where some storm sewers have been constructed. The other situation is where there is already unsewered development on the valley floor and development is beginning in the bordering slopes. The Pasadena Park area on the north side of Spokane Valley is not currently experiencing any critical urban flooding problems but it presents examples of these typical situations.

An example of future conditions is presented in the proposed Northwood addition which will become tributary to this existing storm drain system. If uncontrolled, the new development in previously undeveloped area will increase the peak flow reaching the storm drain system. A small increment like Northwood will probably not overtax the existing facilities, but a succession of similar developments will eventually exceed the capability of the downstream system.

The second situation is demonstrated by areas farther east in Pasadena Park where the valley floor extending from the boundary slopes is permeable and has been developed without storm drainage systems. When development takes place in the relatively impermeable bordering slopes, the resultant increased runoff is confronted with development which has

encroached on the natural sink area of the pervious valley floor. When the runoff becomes large enough or the area for percolation small enough, flooding is the result.

The above conditions are typical of almost any existing or potential development area on the rim of the valley and suggest that an effective, uniform policy should be developed to provide control of drainage from these areas. The most critical storm drainage flow control problem in Spokane Valley involves the sink area of Plouf Creek and the needs for improved drainage for newly developing residential areas which are adjacent and tributary to this sink area. The tributary drainage area of Plouf Creek upstream from Schafer Road is larger than that of Liberty Lake, but the creek has no surface outlet to the Spokane River and does not result in a lake. The entire flow percolates into the valley gravel.



SPOKANE VALLEY

URBAN DRAINAGE PROBLEMS FIGURE 18

When flows are high and in excess of percolative capacity, the waters pond and spread out over adjoining low land from south of Schafer Road to the vicinity of 26th Avenue. This causes inconvenience flooding of ten residential lots in Chester. There is serious concern by the County that percolative areas will be blocked by filling (as is now taking place both north and south of Schafer Road) or that development itself will take place in the ponding areas. This concern is compounded by present intentions of the County to construct road paving and related drainage systems for new residential development in the foothills immediately adjacent to the sink area. This improvement requested by owners will accelerate and increase the quantity of drainage conveyed to the sink area which already causes inconvenience and damage. Additional liability could result. At present the lands are private property and there are no drainage easements or zoning restrictions.

The foregoing specific but typical examples of growing concern in Pasadena Park and Plouf Creek call for the formulation of a general policy to deal with these situations before they become critical problems. A suggested plan of action by Spokane County is as follows:

1. Develop a master drainage plan for the bordering slopes of the entire valley which recognizes the present and forecast runoff and provides for its disposal by one or more of the following alternatives;

    a. Restriction of development on the historic percolation area.

    b. Substitution of an alternative percolation area for subsurface leaching.

    c. Extension of drainage conduit to the river.

2. Develop a policy for storm drainage of slope areas that recognizes the requirements for capacity of these systems to accommodate forecast runoff.

3. Investigate the legal problems that are inherent in both the structural and non-structural aspects of these policies, such as the extent to which a downhill developer is obligated to provide excess capacity in this system to accommodate flows due to future development and the extent to which property owners are obligated to reserve certain areas for percolation of runoff flows generated off of their property that may or may not have percolated in that specific site.

Urban Runoff Institutional and Financial Considerations

The institutional and financial needs for the abatement of flooding problems due to urban drainage are substantially the same as those for flood control discussed in the previous chapter. The same conclusion is reached, namely, that the City and County have all of the necessary planning, regulatory and financing powers either of themselves or through formation of local improvement districts.

The urban drainage problem in North Spokane has special considerations in that City-County cooperation is required. The cooperative approach here could be similar to that discussed under wastewater management. Spokane Valley problems are unique in the approach required for preservation of natural percolative areas to serve drainage from adjoining impervious slopes.

SECTION X

WATER SUPPLY

X. Water Supply

Overview

Water supply development in the study area is characterized by almost exclusive reliance on groundwater. During 1972 approximately 92 percent of the water used in the study area was supplied from groundwater and of this amount 88 percent was supplied by the Spokane Valley aquifer.

Water demand forecast for the overall study area as shown in table 23 indicated that by the year 2020 approximately 86 billion gallons of water will be used annually, nearly a 65 percent increase from 52

TABLE 23

SUMMARY OF FORECAST WATER USE
ENTIRE STUDY AREA

		Annual Water Use - Millions of Gallons						
Unit	Use	1970	1980	1985	1990	1995	2000	2020
Urban Planning Area[2]	Municipal[1]	28,120	32,284	33,910	35,697	37,416	39,183	44,420
	Industrial[2]	12,190	13,709	14,312	14,991	15,680	16,331	18,034
	Agricultural	7,215	7,528	7,678	7,769	7,851	7,710	8,107
	Subtotal	48,525	53,521	55,900	58,457	60,947	63,224	71,061
Non-Urban Planning Area	Municipal[1]	1,873	2,202	2,362	2,536	2,730	2,938	3,839
	Industrial	201	201	343	346	365	369	402
	Agricultural	4,494	4,553	4,581	4,610	4,635	4,668	4,784
	Subtotal	6,568	6,956	7,286	7,492	7,730	7,975	9,025
Study Area	Municipal[1]	29,993	34,486	36,272	38,233	40,146	42,121	48,759
	Industrial[2]	13,391	13,910	14,655	15,337	16,045	16,700	18,436
	Agricultural	11,709	12,081	12,259	12,379	12,486	12,378	12,891
	Total	55,093	60,477	63,186	65,949	68,677	71,199	80,086
Kaiser Trentwood River Diversion	Industrial	6,388	6,388	6,388	6,388	6,388	6,388	6,388
Study Aréa	**Municipal[1]**	**29,993**	**34,486**	**36,272**	**36,233**	**40,146**	**42,121**	**48,759**
	Industrial	**19,779**	**20,298**	**21,043**	**21,725**	**22,433**	**23,088**	**24,824**
	Agricultural	**11,709**	**12,081**	**12,259**	**12,379**	**12,486**	**12,378**	**12,891**
	GRAND TOTAL	**61,481**	**66,865**	**69,574**	**72,337**	**75,065**	**77,587**	**86,474**
Total as Acre Feet/Year		**188,624**	**205,142**	**213,453**	**221,930**	**233,367**	**238,037**	**265,302**
Total as Average mgd		**169**	**184**	**192**	**199**	**207**	**214**	**238**
Total as Average cfs		**261**	**284**	**296**	**308**	**319**	**330**	**368**

[1] Includes Commercial.
[2] Excludes Kaiser Trentwood's Non-Consumptive Cooling Water Use.
[3] Includes Kaiser Trentwood's Non-Consumptive Cooling Water Use.

billion gallons used in 1972. Currently, the urban planning area utilizes 88 percent of the study area's water needs and is forecast to utilize 89 percent by the year 2020. More than half of the water demand for the study area (45 billion gallons) is domestic.

The groundwater resources of the study area can be considered in three categories: (1) the primary aquifer of the Spokane Valley, (2) the basalt aquifer of the Columbia Plateau and (3) all other aquifers including those of the Little Spokane River and Chamokane Creek Valleys. The Spokane Valley aquifer is in a deep valley fill of glacial outwash gravels. Water supply is by recharge sources outside the study area with an estimated mean annual flow of 1000 cubic feet per second. The basalt aquifer consists of horizontal layers of fractured rock interlayed with relatively impermeable materials in which the mechanism of recharge is not well understood and the rate of recharge is estimated to be small. Aquifers in the Little Spokane and Chamokane valleys are gravel deposits recharged from local streams.

The significant uses of surface water are generally non-consumptive, such as hydroelectric power generation, cooling, maintenance of fishery resources and recreation. There is some use for irrigated agriculture, primarily in the Little Spokane Valley.

There is a large number of water suppliers in the study area and users with individual sources including agencies, industries, developer's systems, parks, motels, mobile home parks and schools.

Irrigated agriculture, like residential development and industrial development, is located predominantly on the Spokane Valley aquifer east of the City. A smaller concentration is north of the City. In the eastern part of the valley the agricultural demand is supplied primarily by irrigation districts. In all other areas, the agricultural demand is supplied from private wells.

Of the total amount of water used in the study area, the division between classes of use follows.

CURRENT WATER USE

Class of Use	Total Annual Use Acre Feet
Domestic	96,740
Industrial	24,580
Agricultural irrigation	35,960
Non-agricultural irrigation	1,600
TOTAL	158,880

TABLE 24

DOMESTIC WATER USE BY INDIVIDUAL SYSTEMS

Agency	Ownership	Population	No. Water Services	Avg. Daily Demand, Gal.	Sources by No. of Wells: SV Aquifer	Sources by No. of Wells: Other Ground Water Sources	Per Capita Use gpcd.
Airway Heights, Town of	Municipal	1,197	283	153,000	-	4	128
Cheney Water Department	Municipal	6,500-10,000	1,267	1,000,000	-	4	100-154
Deer Park, City of	Municipal	1,350	602	352,000	-	4	261
Fairfield Water Department	Municipal	514	231	150,000	-	3	291
Latah, Town of	Municipal	169	84	52,500	-	1	311
Medical Lake Water Department	Municipal	1,872	578	408,000	-	-	218
Millwood Water Department	Municipal	1,800	600	263,000	3	-	146
Rockford Water Department	Municipal	367	154	43,000	-	1	117
Spangle, Town of	Municipal	212	87	53,000	-	2	250
Spokane Department Utilities	Municipal	175,250	54,972	50,760,000	16	1	290
Tekoa, City of	Municipal	808	343	200,000	-	3	248
Colbert W.D. #9	Water District	210	60	34,600	-	1	165
East Spokane W.D. #1	Water District	3,200	900	271,000	3	-	85
Four Lakes W.D. #10	Water District	200	51	8,000	-	2	40
Irvin W.D. #6	Water District	1,650	550	210,000	3	-	127
Whitworth W.D. #2	Water District	8,908	2,581	1,190,000	7	2	133
Carnhope I.D. #7	Irrigation District	1,400	459	1,000,000	1	-	714
Consolidated I.D. #19	Irrigation District	6,500	1,702	7,240,000	34	-	1,114
Hutchinson I.D. #16	Irrigation District	2,100	693	262,000	2	-	125
Moab I.D. #20	Irrigation District	167	67	94,500	1	-	565
Model I.D. #18	Irrigation District	4,075	1,200	575,000	4	-	141
North Spokane I.D. #8	Irrigation District	1,900	654	405,000	4	-	225
Orchard Avenue I.D. #6	Irrigation District	3,500	1,000	1,045,000	2	-	299
Pasadena Park I.D. #17	Irrigation District	2,000	670	1,644,000	3	-	822
Trentwood I.D. #3	Irrigation District	3,400	837	1,550,000	5	-	456
Vera I.D. #15	Irrigation District	11,000	2,920	6,490,000	7	-	590
Dishman Water Co.	Private Co.	500	117	60,000	1	-	120
Greenacres Water Works	Private Co.	790	225	52,000	1	-	66
Lakeridge Water Co.	Private Co.	65	27	5,250	-	2	124
Liberty Lake Utilities Co., Inc.	Private Co.	900	386	500,000	-	2	556
Milan Water Co.	Private Co.	50	15	7,500	-	2	150
Modern Electric Water Co.	Private Co.	14,588	4,168	2,290,000	9	-	157
N. Mt. View Water Co.	Private Co.	18	5	3,000	-	1	150
Pleasant Prairie Water Co.	Private Co.	34	10	14,000	1	-	412
Rivilla Water Corp.	Private Co.	97	25	15,000	-	1	150
Washington Water Power Co.	Private Co.	17,900	4,635	3,320,000	13	10	185
Thirty-five Small Companies, mostly Private Development		1,503	494	332,000	-	-	221
Fairchild A.F.B.	Federal	15,097	2,043	2,100,000	3	1	133
Welpinit	Federal & BIA	50	10	10,000	-	2	200
Eastern State Hospital	State	3,580-6,500	5	750,000	-	2	115-195
E. Washington State College	State	4,000-7,000	30	833,000	-	2	119-208
Spokane International Airport	Airport	1,500-3,000	26	465,000	-	2	155-310

Domestic Water Systems

There are approximately 175 separate domestic water systems in the study area exclusive of those which serve a single residence. These systems range in size from that of the City which serves a population of 175,000, down to systems which serve a motel or campground.

These domestic water systems are operated by a variety of governmental agencies and private enterprises such as municipal water departments, water districts, irrigation districts, private water companies, water associations and cooperatives, Federal and state facilities, schools, residential developments, resort and campgrounds and other private enterprises. Summary of domestic water data is shown in table 24.

Municipal Systems

There are 11 municipal systems in the study area. All are in Spokane County except Tekoa, which is in Whitman County. Approximately 62 percent of the study area population is served by municipal systems of which the City alone represents 57 percent. All municipal systems except the City and Millwood are in isolated communities and do not draw from the Spokane Valley aquifer.

In addition to supplying water for domestic use, the City also supplies all or a part of that used by industries located inside its service zone.

A total of seventeen City wells tap the Spokane Valley aquifer with an aggregate installed pumping capacity of 171,000 gpm from 30 pumps. Much of this capacity is concentrated in the eastern part of the City near Spokane Dam, a City owned hydroelectric generating facility which provides electric power for the well pumps.

The City distribution system includes 19 storage reservoirs with total storage of 85,615,000 gallons and is served by 15 booster pumping stations. Chlorination is provided for all water served by the City.

<u>Water Districts</u>. There are five water districts scattered geographically in the study area, with two north of the City, two east and one southwest. The two largest are in the urban area, serving approximately 9000 and 3200 persons, respectively.

Irrigation Districts

There are ten irrigation districts in the study area and all except one are located east of the City in the Spokane Valley. They derive their water supply from wells to the Spokane Valley aquifer. Irrigation districts are the second largest category of domestic water purveyors. Despite the implication of the name "irrigation," these districts are,

with three exceptions, predominantly in the business of providing water for domestic use rather than for large scale commercial agricultural irrigation. The exceptions are the Vera, Consolidated and Moab Irrigation Districts which serve major agricultural areas.

Private Water Companies. There are eleven companies in this category ranging in size from a service population of 16 to over 17,000. Two companies, Modern Electric Water Company and Washington Water Power, are the largest, with service populations of more than 14,000 and 17,000, respectively. Of the remaining nine, six have service populations of less than 100 and three have service populations between 100 and 1000.

The Modern Electric Company is also engaged in electrical power distribution (purchased wholesale from Bonneville Power Administration) within the same area as its water distribution.

Washington Water Power Company (WWP) is the region's primary generator and distributor of electrical power and provides water to ten service areas.

Water Associations and Cooperatives. Of the seven systems in this category, six serve populations of 100 and less. Most of these systems are at isolated locations. Four of the seven are in the Columbia plateau areas and draw their supplies from the basalt aquifer.

Other Systems

The most important of the systems in categories other than those considered above is that of Fairchild AFB, with a service population of approximately 6000. Fairchild AFB, located approximately 8 miles west of the City on the Columbia plateau, has the third largest water system in the study area considering population served in a single contiguous area, being exceeded only by the City and Modern Electric Water Co. The AFB takes the larger part of its supply from three wells in the primary aquifer, the balance coming from a single well in the basalt aquifer.

Summary of Present Use

Annual water use for the study area for each of the four major categories of use is summarized in table 25. For all categories of use, the groundwater source is predominant and, overall, represents 92 percent of consumptive use. Domestic use is the largest category of use at 60.9 percent followed by agricultural irrigation and industrial use, at 22.6 percent and 15.5 percent, respectively. Non-agricultural irrigation, not otherwise accounted for under domestic use, is of little significance.

TABLE 25

ANNUAL WATER USE
STUDY AREA SUMMARY, 1972

Use Category	ANNUAL WATER USE								
	Billion Gallons			Acre Feet			Percent of Total		
	G.W.[1]	S.W.[1]	Tot.[1]	G.W.	S.W.	Tot.	G.W.	S.W.	Tot.
Domestic	31.52	-	31.52	96,740	-	96,740	60.9	-	60.9
Industrial[2]	5.64	2.37	8.01	17,310	7,270	24,580	10.9	4.6	15.5
Agricultural	9.93	1.79	11.72	30,480	5,480	35,960	19.2	3.4	22.6
Non-Agricultural Irrigation	0.52	-	0.52	1,600	-	1,600	1.0	-	1.0
TOTAL	47.61	4.16	51.77	146,130	12,750	158,880	92.0	8.0	100.0

[1]G.W. = Ground Water Source, S.W. = Surface Water Source, Tot. = Total G.W. and S.W.
[2]Not including Kaiser Trentwood's non-consumptive cooling water use.

The irrigation component of domestic water use, including home landscaping, gardens and pasture, is not precisely measurable but can be estimated from the annual use pattern. The estimated use for domestic irrigation determined on this basis is 15,000 million gallons per year or approximately 50 percent of the total domestic use. For suburban areas considered alone, the irrigation use is as high as 75 percent of the total annual use. Domestic indoor use is, therefore, about 30.4 percent of the total study area use. These components individually are approximately 35 percent larger than agricultural irrigation and one hundred percent more than industrial use.

The strictly domestic component of per capita use at 139 gallons per capita day (gpcd) for the study area as a whole is high compared with national averages. The unusually high domestic indoor and outdoor uses appear to be the consequences of the abundance and relative low cost of water in the study area and the demand created by the warm dry summer season. The primary aquifer provides 88.5 percent of the groundwater supply and 3.2 percent and 8.3 percent are supplied by the Little Spokane Valley and basalt and other aquifers, respectively.

The only significant surface water withdrawal from the Spokane River is for industrial purposes, amounting to only 2372 million gallons annually. Withdrawal for the Kaiser Trentwood cooling water diversion is 6387 million gallons annually. The respective withdrawal is equal to an average flow of 10 cfs and the Kaiser Trentwood diversion to 27 cfs. For comparison, the mean annual flow of the Spokane River at Spokane is 6927 cfs.

By comparison to the available flow, the surface water use from the Little Spokane River is proportionately more significant. The predominant use of surface water from the Little Spokane is agricultural irrigation and amounts to 2489 acre feet annually, equal to an average of 3.4 cfs. For the peak month in the irrigation season, this diversion is estimated to be of the order of 11.3 cfs. For comparison, the Little Spokane River has a mean annual flow of 665 cfs and a minimum flow of 63 cfs at the Dartford gage.

A synthesized annual pattern of water use for all categories reveals that the peak use in July is equal to 18.4 percent of the total average annual use. For groundwater from all aquifers, the July use is 8847 million gallons and for the primary aquifer is 7753 million gallons. The peak month withdrawal rate for the primary aquifer is equal to a rate of 394 cfs. This is a significant proportion of the estimated 1000 cfs flow of groundwater entering the study area.

Forecast Water Use

Scope. Forecasts of water use are developed for three categories: municipal, industrial and agricultural, for both the urban and non-urban planning areas 1980 to 2000. These forecasts, based on

forecasts of population and economic activity and on evaluated trends in water use, are a prerequisite element of the wastewater forecast discussed previously.

Municipal Use. The general method used in forecasting municipal use is based on the evaluation and trending of present per capita use. Due to the wide range of present use throughout the study area, the evaluations of forecast per capita use are made on small units of area, except that the City is treated as a whole. The resultant forecast per capita use is forecast for the City from the present 290 gpcd to 304 gpcd at year 2000. Certain areas in Spokane Valley are forecast to show a significant decrease as lot sizes become smaller, with decreases approaching fifty percent. Other areas in Spokane Valley are forecast to show a moderate increase, due mainly to an evaluated increase in commercial and small industrial components. Similar variations result from detailed consideration of areas north of Spokane. The forecast total use is the product of the forecast per capita demands and the forecast population.

Industrial Use. The industrial water use forecast is based on the forecast employment in large industry as previously discussed under wastewater flow forecasts. The water intake by industry that does not appear in the wastewater flows or is incorporated in the product is negligible. Therefore, the water use and wastewater flows are substantially equal.

The Kaiser Trentwood cooling water diversion from the Spokane River, which presently averages 17.4 mgd, is set out separately from the rest of the industrial use in the Spokane Valley. This large use is the only significant surface water use in the urban planning area, all other being supplied from groundwater. It is assumed that this use will remain unchanged throughout the study period, based on Kaiser's statement that there are no plans for change.

Agricultural Water Use in the Urban Planning Area. Substantially all of the commercial irrigated agriculture in the urban planning area is in the Spokane Valley. At present approximately 7900 acres out of the 25,500 acres devoted to agriculture in the Spokane Valley are under irrigation. Approximately 5100 acres are served by irrigation districts and the remainder by private sources. The forecast land use data indicate that urban development will reduce the total acreage developed to agriculture to 22,200 acres by 2020. The present proportion of irrigated agricultural land to total agricultural land is 31 percent. It is estimated that as the amount available for agriculture is reduced there will be pressure for increased production and crop value provided by irrigation. This is recognized by the forecast that 40 percent of the 22,200 acres of agricultural land will be irrigated by 2020, bringing the total irrigated acreage to 8900, about 1000 acres more than at present. The present average application rate for the Spokane Valley, at 2.8 feet per year, is assumed to apply throughout the study period.

<u>**Agricultural Water Use in the Non-Urban Area.**</u> **The forecast agricultural water use outside the urban planning area is considered in elements corresponding to Water Resource Inventory Areas (WRIA), as shown in figure 19.**

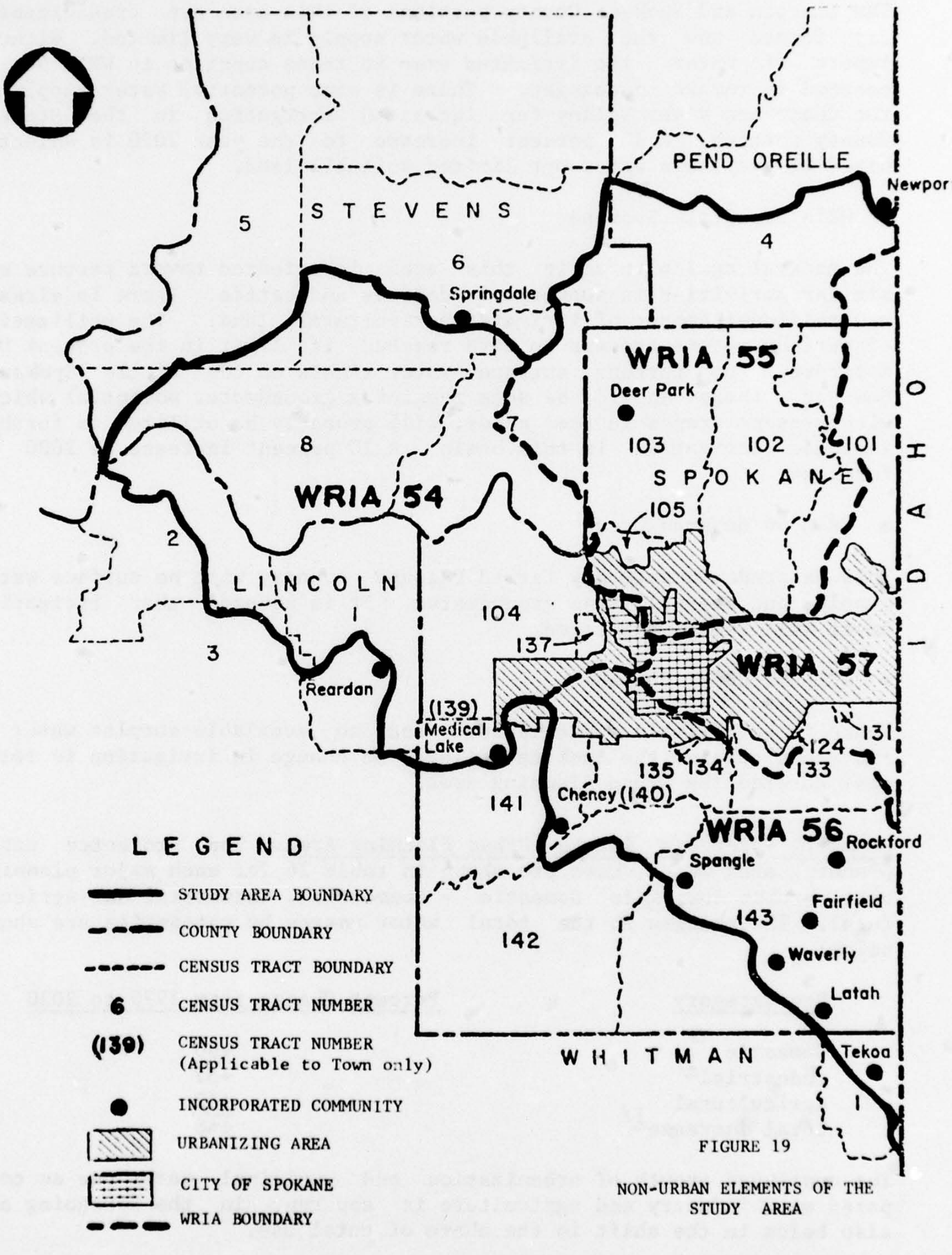


FIGURE 19

NON-URBAN ELEMENTS OF THE STUDY AREA

• WRIA 54 Lower Spokane

The Lincoln and Spokane County portions of this area are predominantly dry farmed and the available water supply is very limited. Without import of water, the irrigated area in these counties in WRIA 54 is assumed to remain unchanged. There is some potential water supply in the Chamokane River Valley for increased irrigation in the Stevens County portion. A 10 percent increase to the year 2020 is selected based on available water but limited suitable land.

• WRIA 55 Little Spokane

The general agricultural in this area is oriented toward pasture and similar activities in support of dairies and cattle. There is already a significant amount of irrigated agricultural land. The utilization of surface waters appears to have reached its limit in the present DOE moratorium on further surface water rights on the Little Spokane. However, there should be some remaining groundwater potential which, with present trends in food needs, will probably be utilized to further increase irrigation in this basin. A 10 percent increase by 2020 is forecast.

• WRIA 56 Hangman Creek

This is predominantly dry farmed Palouse country with no surface water supply and very limited groundwater. It is assumed that irrigation level will remain unchanged.

• WRIA 57 Upper Spokane

There is both little suitable land and no available surplus water in the areas outside the Spokane Valley. No change in irrigation is forecast outside the urban planning area.

Summary, Water Use in the Urban Planning Area. The projected urban planning area water uses are shown in table 26 for each major planning unit, broken down into domestic - commercial, industrial and agricultural. The changes in the total water usages by categories are shown below:

Use Category	Percent Change from 1970 to 2020
Domestic	+60
Industrial 1/	+37
Agricultural	+12
Total increase 1/	+46

The continued growth of urbanization and municipal water use as compared with industry and agriculture is apparent in the foregoing and also below in the shift in the share of total use.

TABLE 26

SUMMARY, PROJECTED WATER USE
URBAN PLANNING AREA

Unit	Use	Annual Water Use - Millions of Gallons 1970	1980	1985	1990	1995	2000	2020
City[1]	Municipal[2]	18,418	20,057	20,491	21,024	21,502	21,995	23,572
	Industrial	1,278	1,427	1,555	1,694	1,851	1,934	2,172
	Agricultural	-	-	-	-	-	-	-
	Subtotal	19,696	21,484	22,046	22,718	23,353	23,929	25,744
Spokane Valley	Municipal[2]	7,497	9,450	10,132	10,837	11,498	12,151	14,290
	Industrial[3]	10,443	10,720	11,122	11,538	11,965	12,384	13,527
	Agricultural	7,215	7,528	7,678	7,769	7,851	7,710	8,107
	Subtotal	25,155	27,698	28,932	30,144	31,314	32,245	35,924
North Spokane	Municipal[2]	1,307	1,869	2,354	2,873	3,424	4,008	5,887
	Industrial	1,363	1,455	1,527	1,651	1,755	1,903	2,223
	Agricultural	-	-	-	-	-	-	-
	Subtotal	2,670	3,324	3,881	4,524	5,179	5,911	8,110
Orchard Prairie	Municipal[2]	26	36	36	40	40	44	51
	Industrial	2	2	3	3	4	5	6
	Agricultural	-	-	-	-	-	-	-
	Subtotal	28	38	39	43	44	49	57
West Plateau	Municipal[2]	106	106	131	157	186	219	354
	Industrial	104	105	105	105	105	105	106
	Agricultural	-	-	-	-	-	-	-
	Subtotal	210	211	236	262	291	324	460
Fairchild AFB	Municipal[2]	766	766	766	766	766	766	766
	Industrial	-	-	-	-	-	-	-
	Agricultural	-	-	-	-	-	-	-
	Subtotal	766	766	766	766	766	766	766
Total Urban Planning Area	Municipal[2]	28,120	32,284	33,910	35,697	37,416	39,183	44,920
	Industrial	13,190	13,709	14,312	14,991	15,680	16,331	18,034
	Agricultural	7,215	7,528	7,678	7,769	7,851	7,710	8,107
	Subtotal[3]	48,525	53,521	55,900	58,457	60,947	63,224	71,061
Kaiser Trentwood River Diversion	Industrial	6,388	6,388	6,388	6,388	6,388	6,388	6,388
Total Urban Planning Area	Municipal[2]	28,120	32,284	33,910	35,697	37,416	39,183	44,920
	Industrial	19,578	20,097	20,520	21,379	22,068	22,719	24,442
	Agricultural	7,215	7,528	7,678	7,769	7,851	7,710	8,107
	GRAND TOTAL[4]	54,913	59,909	62,288	64,845	67,335	69,612	77,449
Total as Acre Feet/Year		168,473	183,801	191,100	198,944	206,584	213,570	237,614
Total as Average mgd		151	165	172	179	186	192	213
Total as Average cfs		234	255	265	276	286	296	329

[1] Including Moran Prairie and Southwest Units.
[2] Including Commercial.
[3] Excluding Kaiser Trentwood's Non-Consumptive Cooling Water Use.
[4] Including Kaiser Trentwood's Non-Consumptive Cooling Water Use.

Use Category	Percent of Use 1970	2020
Domestic	58.0	63.2
Industrial[1/]	27.2	25.4
Agricultural[1/]	14.8	11.4
Total[1/]	100.0	100.0

[1/] Excluding Kaiser Trentwood's non-consumptive cooling water use.

Summary, Water Use in Non-Urban Planning Areas. The forecast of water use outside the urban planning area indicated the following trends:

Use Category	Percent Change from 1970 to 2020
Domestic	+105
Industrial	+100
Agricultural	+ 6
Total increase	+ 37

The domestic water use is increasing faster than the corresponding increase in the Urban Planning Area, although the absolute increase is about one-tenth as much. The domestic use of water, although smaller than the agricultural use, is becoming more significant.

Use Category	Percent of Use 1970	2020
Domestic	28.5	42.5
Industrial	3.1	4.5
Agricultural	68.4	53.0
Total	100.0	100.0

This indicates that, although there are large percentage increases in municipal requirements, the remote areas are still predominantly agricultural with respect to water use.

Conclusions and Suggestions

The present total annual demand on the Spokane Valley aquifer for municipal, industrial and agricultural use is approximately 42 billion gallons or 129,000 acre feet annually. This is equal to an average withdrawal rate of 178 cfs or approximately 20 percent of the estimated flow entering from Idaho. The forecast use at year 2020 is approximately 46 percent greater or 260 cfs average withdrawal. The forecast withdrawal is 26 percent of the estimated annual renewal. Expressed in terms of average, the forecast requirements appear to be well within the capability of the source. The impact is to reduce the amount available for interchange with the Spokane and Little Spokane Rivers. If the entire increment of 82 cfs were to be at the expense of the interchange farthest downstream, it would reduce the augmentation to the lower Little Spokane River by 40 percent.

Since these interchanges have such an important impact on quality, and temperature in particular, these forecast increases in withdrawal

should be a matter of concern. The USGS simulation of the Spokane Valley aquifer currently being developed would be an ideal tool to study this problem in conjunction with the surface water simulation developed by this study.

The fact that the groundwater withdrawals are significantly higher during the summer, estimated to average 394 cfs during the peak month, could aggravate the situation beyond what is apparent based on averages. Another consideration not covered is the concurrent construction of additional facilities for withdrawal by the Bureau of Reclamation in its East Greenacres[1/] project to irrigate 5340 acres. This project would withdraw at least another 15 cfs average or 48 cfs in the peak summer month. Combined with the present peak withdrawal rates in the study area, this makes approximately 440 cfs total, approaching 50 percent of the average inflow.

It is suggested that recognition be given to the fact that the Spokane Valley aquifer has finite limitations and that an overall view, considering both Idaho and Washington, needs to be developed.

Water quality implications other than interchange with surface waters deserve consideration also as withdrawals increase. These would grow out of the reduced dilution and flushing which apparently are such an important factor in reducing the impact of percolate from on-site disposal (septic tanks) in the Spokane Valley.

The quantities of water used in the Spokane Valley indicate over irrigation. This is also recognized by agricultural advisers. The extreme low cost of water does not encourage thrift in its use. On the other hand, there is no economic need to raise rates. To raise them for control is unfair to those who do make prudent use of the supply. An educational program to keep water use in phase with need is required not only for Spokane Valley but throughout the urban area. The availability of low cost water for landscape irrigation is one of the most important factors in the general quality of life in the Spokane area. It is, therefore, important to maintain both the low cost and availability of the supply.

There are an unnecessarily large number of agencies in the business of purveying water. This provides neither optimum service nor optimum control. It is suggested that consideration be given to consolidation of agencies either as a separate County project or as an adjunct to the necessary institutional arrangements for implementation of wastewater management.

The records of water use, particularly for agriculture, are inadequate. The Department of Ecology water rights file does not currently provide the tool necessary for control. The difficulties experienced by DOE in revising appropriations in the Little Spokane watershed emphasize the need for an improvement in records of actual water use.

[1/] Located in Idaho outside the study area.

SECTION XI

WATER QUALITY ENHANCEMENT AND FLOW AUGMENTATION

XI. Water Quality Enhancement and Flow Augmentation

Introduction

Earlier sections in this report provided study results regarding improvement of water quality deficiencies which are due to man-made pollution within the study area. The potential for improvement of undesirable natural conditions, while not a major effort in this study, has been considered, as discussed in this section. These undesirable natural conditions are considered in this report, as are those created by operations outside of the study area.

Spokane River and Long Lake

Problem. The primary existing water quality defects of the Spokane River as it enters the study area are excessive coliform count and excessive temperature during the summer season. The excessive coliform counts are expected to be corrected with future enforcement of existing wastewater discharge standards. Water temperature conditions are the result of natural conditions rather than man's intervention and therefore are expected to continue indefinitely unless artificial means are taken to change them. High water temperature makes the stream an unattractive environment to certain salmonid fish and also contributes to the high rate of biological activity in Long Lake.

Normal low stream flows in some summer seasons are undesirable for several reasons including loss of hydroelectric power production, aesthetic and recreational losses, and contribute to the seasonal eutrophication of Long Lake. The summer low flow is likewise a natural result and not a consequence of man's intervention. To some limited extent it could be alleviated by drawdown of stored volume in Coeur d'Alene Lake, but this is not done because of its undesirable effect on power production and the use of the lakefront particularly during the summer recreation season.

In Long Lake there is strong stratification during the summer season due to the addition of warm river water to a reservoir filled with cold water at the beginning of the summer season. The lack of vertical circulation will result in very low dissolved oxygen levels at depth even with complete removal of point source pollutional loads. The lake is

man-made and the method of withdrawal is a fixed feature of the dam and power generation equipment.

Alternatives. There are at least three ways in which lower temperatures could be induced in the Spokane River. One would require seasonal storage upstream from Coeur d'Alene Lake to provide higher summer flows which would result in lower heat gain from the ambient water in the flowing sections in the river downstream from Post Falls. Another would be to induce outflow from a lower stratum in Coeur d'Alene Lake. A third would be to increase the volume of cold groundwater interchange.

The effect of seasonal storage upstream from Coeur d'Alene Lake would probably be minimal. Funk et al (1973) point out that "the discharge from Post Falls Dam had little secondary effect on temperatures. The controlling effect appeared to be direct solar radiation upon Coeur d'Alene River-Lake, and to some smaller extent upon the Spokane River."

Withdrawal of water from a lower level in Coeur d'Alene Lake would require an eight feet or more diameter conduit from the lake outlet to Post Falls Dam, a distance of nine miles. It would be required only for a fraction of the summer flow to reduce the total temperature. The length and size of facility would appear to give this alternative little feasibility.

The groundwater interchange can be increased only by increasing the level of the Spokane Valley water table which in turn can be accomplished by increasing the rate of recharge. There is available in the May-June runoff of the Spokane River large volumes of low temperature water that are not used beneficially in the study area. If a small portion of these excess flows could be induced into the Spokane Valley aquifer for later discharge into the Spokane and Little Spokane Rivers, the benefits of lower temperature and summer stream augmentation could be realized. Typical excess water temperatures are about the same as groundwater temperatures, about 11°C. Therefore each cfs of groundwater would lower one cfs of surface water at its typical summer high of 22°C by 5°C.

There is a feasible area for recharge of the Spokane Valley aquifer by Spokane River waters in the vicinity of the Idaho boundary. The geological consultant estimated that artificial recharge at the rate up to 10 cfs per acre or 20 feet per day is feasible. For a 160 acre site at a conservative 10 feet per day, the quantity that could be injected over a two-month period at the rate of 800 cfs would be 48,000 cfs days. A complex study would be required to determine the degree of attenuation and when this wave of injected water would reach the interchange area 6 to 8 miles downstream. The indicated average rate of flows in the aquifer is approximately 60 feet per day or 88 days per mile which would mean over a year to reach the interchange reach of the river. The attenuation would undoubtedly be great so that the incre-

mental interchange would probably not exceed 100 cfs. If this were the case, the temperature of a 1000 cfs river flow would only be lowered approximately 0.5°C. For a 1000 cfs flow now, the lowering is approximately 2°C from the Idaho boundary to the east boundary of the City. This alternative offers a possible future reduction of 2.5°C total.

For the temperature potential alone this alternative does not offer sufficient incentive to seek implementation. In combination with flow benefits under forecast future withdrawals it may be worthwhile. The U.S. Geological Survey groundwater simulation model when fully developed could be utilized here to evaluate a possible future need.

Flow augmentation as an alternative for both the Spokane River and Long Lake in significant amounts is physically feasible only by storage on the tributaries to Coeur d'Alene Lake. The beneficial amount of flow augmentation is most critical with respect to the exchange rate through Long Lake. It would appear that for exchange rates of the order of once per month, the eutrophication problems become minimal even with the present levels of phosphorous loading. This is an approximation of the general finding by Soltero et al (1975) that retention time directly affected the trophic state of Long Lake.

Storage could be provided by the potential Enaville Reservoir on Coeur d'Alene River approximately 22 miles upstream from Lake Coeur d'Alene. The Enaville project previously studied by the Corps of Engineers is not currently under consideration. The project if implemented would have the physical capability to provide the necessary level of flow augmentation. This, then, is another physically feasible method of imparting water quality and temperature control within the basin by external measures not related to wastewaters or pollution.

For power production reasons, Long Lake is maintained at a maximum pool level of 1536 feet throughout the summer season. The minimum operating pool level is 1512, five feet above the tops of the penstock inlets. Lowering the summer pool level from 1536 to 1512 reduces the net head on the Washington Water Power Company power turbines by eight percent causing a corresponding eight percent loss in power generation capacity. This suggests a possible tradeoff, lost power generation versus phosphorous removal chemicals, if the level of biomass activity at pool level 1512 were acceptable without phosphorous removal. The approximate loss in power revenue July through December for a mean flow of 4061 cfs[1/], 80 percent water to wire efficiency and $.004 per kwh is approximately $125,000. The cost for phosphorous removal chemicals for the July through 15 October period at 30 mgd flow is approximately $200,000. This appears to provide strong incentive for seeking to avoid phosphorous removal if acceptable conditions could be obtained at lowered pool.

[1/] Plus 50,000 cfs days lost through drawdown of lake at a time when it cannot be used.

Another measure that has been aired to impact water quality in Long Lake is alteration of the level at which water is drawn for release from Long Lake Dam. The present configuration of the outlet works provides penstock inlets approximately 30 feet below the surface at normal summer pool. (Pool 1536, top of penstock 1507, bottom of penstock 1491 feet elevation.) The quality of the water, particularly its temperature, below Long Lake Dam indicates that the water being drawn off is almost entirely from the surface layer. It has been suggested that draw off from the lower layers, in which nutrients are accumulating and oxygen levels are being depleted by stratification, would improve the trophic condition of the lake. A method of encouraging draw off from a lower level would be to construct lower level penstock intakes. A hydraulic model study extending a significant distance from the dam is a prerequisite to determine whether such a construction would have the desired effect. A biochemical analysis to determine the subsequent effect on biological activity should follow the model study.

The draw off of lower level waters opens the possibility of creating undesirable water quality effects downstream that would not be worth the improvements upstream. It could well be that Long Lake is at present performing an important function in controlling eutrophic conditions in the Spokane River arm of Franklin D. Roosevelt Lake by acting as a nutrient trap during the critical summer season. Continuous release of the nutrient rich lower layers could create downstream problems.

<u>Feasibility for Action on Alternatives</u>. A number of unconventional alternatives for modification of Spokane River and Long Lake water quality have been suggested above. In summary they are:

1. Making summer withdrawals of Spokane River from a lower level in Coeur d'Alene Lake.

2. Creating storage upstream from Coeur d'Alene Lake to augment summer flows in the Spokane River and increase the Long Lake exchange rate.

3. Artificially recharging the Spokane Valley aquifer to increase groundwater interchange with the Spokane River to lower temperature and augment flow.

4. Reducing summer pool level in Long Lake to increase effective exchange rate.

5. Creating low level draw offs at Long Lake Dam to diminish the effects of stratification.

Items 1 and 2 appear to have little economic feasibility and are not suggested for any action. Item 3, although of doubtful value to lower river temperature or to raise river flow significantly, has significant added interest for its possible long-range usefulness to augment the groundwater supply to meet forecast growth. For this reason it is

suggested that the theoretical problems of artificial recharge be one of the items considered in the USGS modeling study of the hydraulic aspects of the aquifer.

Items 4 and 5 are possible imperfect alternative solutions to a problem currently being resolved through modification and expansion of the existing City STP. However, these facilities will have high operation costs extending indefinitely into the future. Having the means to alleviate the eutrophication problem in Long Lake permits some experimental consideration of alternatives to possibly reduce heavy operational costs. The simulation model has shown that seasonal phosphorous removal will probably have the same impact in reducing summer eutrophication as year-round removal. Alternatives 4 and 5 above are means by which further reduction might be sought in the phosphorous removal season and are suggested for further investigation. These alternatives, which have been characterized as an imperfect solution, bring into focus the question of how much the public is willing to pay for varying degrees of water quality improvement when that particular feature of improvement does not impact on public health. For example, if this type of solution could limit eutrophic activity to acceptable levels in say 7 out of 10 years, would that be enough improvement for the price?

Little Spokane River

The Little Spokane River is a well behaved stream with a well sustained summer flow provided by nature. The only quality defect is in regard to the stream as a fishery and includes higher temperatures resulting from loss of cover caused by removal of streamside trees throughout the agricultural areas. Here is an opportunity to artificially reverse a degradation of the environment through restoration of selected streams by protection of their banks from intensive use. An educational and tax incentive approach appear to be the most feasible means of implementation.

Hangman Creek

The primary defect in Hangman Creek is its flashy nature of high runoff and lack of significant sustained flow in the season without precipitation. Man's agricultural activity has increased the rate of runoff and added high rates of soil erosion to the problems.

The most serious water quality problem is the heavy silt load from erosion of the Palouse soils. The basic alternative is a non-structural one, namely revision of agricultural practices.

There appears to be little opportunity to control the flashy high flows or to sustain summer flows by structural means on Hangman Creek due to a lack of suitable sites for storage.

SECTION XII

COMMENTS

XII. Comments

Introduction

This section provides an overview of study coordination as it relates to comments on the study results made by local, State and Federal agencies as well as members of SPRIBCO, CITCOM and the general public. An overview of study management and public participation is discussed in Section I, Introduction. A detailed discussion of public participation is contained in Section VI, Public Involvement and Plan Formulation for Wastewater Management. A key element in Study Management and Public Participation was the review by study participants of the interim draft documents produced throughout the study. These documents which make up the appendixes are listed in exhibit 4. Many of the documents were furnished to each SPRIBCO member and were made available for general public review and information at the Spokane Public Library and through the Spokane County Engineer's office. In addition, certain key elements of the study report and appendices were distributed as discussed below.

The draft technical report which contains a summary of the study results and suggestions was furnished to each member of the Spokane River Basin Coordinating Committee and local, State and Federal agencies for information and review. A list of these agencies is contained in table 27.

TABLE 27

LIST OF AGENCIES WHICH WERE FURNISHED
THE TECHNICAL REPORT FOR REVIEW AND COMMENT

Area		Agency
Local	1.	Each member of the Spokane River Basin Coordinating Committee
	2.	Spokane County Health District
State	1.	Washington State Department of Social and Health Services
	2.	Washington State Department of Ecology
Federal	1.	U.S. Environmental Protection Agency - Region X
	2.	Department of Housing and Urban Development
	3.	Bureau of Outdoor Recreation
	4.	Fish and Wildlife Service
	5.	Bureau of Reclamation
	6.	Geological Survey
	7.	Public Health Service
	8.	Soil Conservation Service

The study results contained in the technical report were presented at an interagency workshop held 1 October 1975 in the Seattle District office. The meeting was attended by representatives of local, State and Federal agencies who have an interest in the study. A list of these agencies is contained in table 28.

TABLE 28

LIST OF AGENCIES ATTENDING SEATTLE DISTRICT
1 OCTOBER 1975 INTERAGENCY WORKSHOP

Area		Agency
Local	1.	City of Spokane — Also represented Spokane River Basin Coordinating Committee
	2.	Spokane County
State	1.	Washington State Department of Ecology
	2.	Washington State Department of Social and Health Services
	3.	State of Washington Water Resources Research Center
Federal	1.	U.S. Environmental Protection Agency
	2.	Fish and Wildlife Service
	3.	Bureau of Outdoor Recreation
	4.	Bureau of Reclamation
	5.	Geological Survey
	6.	Department of Housing and Urban Development
	7.	Seattle District Corps of Engineers
Other	1.	Kennedy-Tudor Consulting Engineers

Each member of CITCOM was furnished, for information and review, section 9 from the technical report, Development of a Regional Wastewater Plan. This section contains formulation and evaluation of alternative wastewater management plans and the suggested plans which meet requirements of PL 92-500.

The issues developed from review by these groups and the general public are presented in attachment 4, along with responses by the Corps. Comments received are summarized below.

Public Meeting

The study results and suggestions were presented at the final public meeting held in Spokane on 20 January 1976. Of the 162 persons who completed the attendance cards, 16 gave testimony at the meeting. Two of these, along with eight who did not speak, presented written statements. It was estimated that nearly 200 persons were in attendance, representing city offices for Spokane, Millwood, Cheney and Medical

Lake, health groups, environmental groups, water districts, Federal agencies, journalism, engineering, real estate and land developers, professors, students, local citizens and involved Idaho groups.

The public meeting was chaired by Mr. Cy Geraghty, Spokane City Council and chairman of the Spokane Regional Planning Conference. It was under the auspices of this organization that the study was conducted. Mr. Ray Christensen, chairman, Spokane County Board of Commissioners, expressed the importance of this study to the Spokane area and its relation to proposed plans and plans already adopted by the County.

Mr. John Arnquist, Spokane Regional Manager for the Department of Ecology, in opening comments, indicated in part that:

> . . . The study is basically an effort initiated to meet certain State and Federal planning requirements which are now governed by regulations promulgated by the Water Pollution Act of 1972.

He emphasized that:

> . . . a vast wealth of information has been gathered by the Corps and their Consultants, which along with the study document itself, essentially meet the planning requirements above and also provide the basis for local planning efforts to continue toward the eventual creation of the necessary documents required for implementation of the Comprehensive Wastewater Management Plan for (the Spokane) area. This information has also provided the Department of Ecology the necessary data with which to generate the total basin plan for the area identified as a 303e plan, which come from that section of the Federal Water Quality Act. This 303e document, when completed, will be an inventory of waste problems within the basin, the goals to be achieved and the mechanism with which to accomplish the goals.

The study results were generally accepted by the meeting participants. Further study of possible contamination of the aquifer and development of a monitoring system to provide additional data on water quality in the aquifer as suggested by the study were strongly endorsed. Minor concerns related to land and surface water disposal objections by those in the involved areas; non-acceptance by farmers of treated sewerage for irrigation of their lands; pollution of Spokane Lake from direct discharge of wastes; need for a commission to supervise water use and disposal, but of a local, not Federal, nature; social and economic needs not being fully utilized in the decision process; and land cost estimates being too low.

Press coverage of the final public meeting emphasized the need for more valid, current, year-round monitoring of the Spokane aquifer and extension of the Crosby study to testing to include the wet seasons and other areas in the valley. Some voiced concern at the suggested plan and felt that a waiting period was needed for further studies to deter-

mine if there is contamination of the aquifer by septic tanks and therefore a real need for the cost and disruption caused by placing sewers. The advocates of the study results indicate that now is the time to make plans to prevent contamination that may prove difficult, if not impossible, to eliminate as population density increases over the aquifer. Efforts by interests in Idaho to place a moritorium on new septic tank installations has demonstrated the concerns over possible pollution of the aquifer. Several individuals in the Spokane area feel that Spokane should also place similar controls on new installations.

Views of Non-Federal Interests

Responses solicited from non-Federal interests produced replies from Spokane County Health District, Washington State Department of Social and Health Services, Washington State Department of Ecology, Latenser Engineering, Washington State University and SPRIBCO. Concerns expressed involved, again, monitoring the water supply and quality of the Spokane Sewerage Treatment Plant and formulation of an organization of local concerns as a commission to manage the water resources of the area. The cost effectiveness of various plans and their relation to existing commitments were also commented on.

DOE specifically recommends that a program should be established to control the construction and development of package treatment plants or lagoons for large residential and commercial complexes. Where package plants are approved they should be structured so as to fit into an overall plan which will begin to form the basis for a sewerage collection/interception system, where possible. All package treatment plants that are approved should be placed under a single operating authority. DOE also recommends a monitoring system to protect the aquifer. The selected plan should consider the interception and transmission of industrial-commercial-residential wastewater to the central waste treatment facility where appropriate. They oppose a commission with DOE at the head, indicating this should be a local (County) group. DOE also questioned the reliability of the mathematical model. They do not agree with the suggestion that phosphorous be removed through the Spokane STP on a seasonal basis but continue year-round phosphorous removal as currently planned.

Review by Other Federal Agencies

Federal agencies which responded to the project include Environmental Protection Agency, Housing and Urban Development, Bureau of Outdoor Recreation, Fish and Wildlife, Bureau of Reclamation, Public Health Service, Soil Conservation Service and USGS.

The need for a local commission was generally agreed to. Several errors in text of the report were noted and these were corrected. The

reliability of the water quality model was questioned, but the consultants did not feel the criticism was justified. In general, agreement with the report was indicated by the Federal agencies commenting.

Public Attitude

The overall public attitude toward the project indicated concern that the project did not go far enough in determining the effects of septic tanks on the aquifer, and that further monitoring should be done before any final decisions are made. Some interests felt that enough evidence was presented to proceed with the sewer system, and Idaho actions were cited as examples.

SECTION XIII

CONCLUSIONS AND RECOMMENDATIONS

XIII. Conclusions and Recommendations

Introduction

This study has developed alternative regional wastewater management plans for the metropolitan Spokane urban area, including implementation plans with institutional and financial arrangements. The study has also included identification and evaluation of the needs for abatement of urban runoff pollution and flooding with alternative solutions; identification and evaluation of the needs for correction of flood control problems and development and evaluation of alternative corrective measures; and development of planning suggestions for protection of the area's water supply resources.

This information was developed to provide a framework to assist the State and local government in their decision making process for meeting the goals and objectives of Public Law 92-500 as well as to provide planning information regarding the other related water resource elements - flood control, urban runoff and water supply.

The study provides suggestions within a planning framework for implementation by local interests with available assistance from other local, State and Federal agencies. It provides major input to Section 303e (Public Law 92-500) plans for the Spokane River basin in Washington State being prepared by Washington State Department of Ecology.

Conclusions

Wastewater Management. The formulation of the wastewater management plans considered different types of sewage treatment/disposal techniques and varying levels of regionalization in determining the optimum combination of planning elements. The optimum plan was determined by combining the cost-effective analysis with economic, social and environmental considerations.

Basically, two treatment concepts were considered applicable for meeting 1983 best practical wastewater treatment technology criteria:

1. Surface water disposal (to rivers).
2. Land application (overland flow, irrigation, percolation).

Within the metropolitan Spokane region, five possible service area combinations were considered for regionalization of services:

1. The City (C), North Spokane (NS) and Spokane Valley (SV) separate.

2. All three areas together.

3. The City and North Spokane combined, with Spokane Valley separate.

4. The City and Spokane Valley combined, with North Spokane separate.

5. North Spokane and Spokane Valley combined, with the City separate.

Combining all treatment/disposal combinations with the five possible service areas resulted in 57 possible alternative plans. By using a cost-effective screening process, eight representative plans, plus the "no action" plan, were selected for further study. A total of 31 environmental, social and economic evaluation factors were used to select the suggested plan. Detailed evaluation of the nine alternative wastewater management plans revealed the following conclusions.

Optimal Plan. Plan A has been selected by local interests as the optimal plan for satisfying the 1983 requirements of Public Law 92-500. Plan A provides for the following:

1. Wastewater treatment at the existing Spokane STP (upgraded) for City and North Spokane.

2. Separate treatment facility near Felts Field, at an appropriate time in the future, to serve Spokane Valley.

3. Operation of both facilities with effluent disposal to surface waters.

The optimal plan also includes the adoption of a future contingency plan, Plan D, to upgrade Plan A to meet 1985 interpreted goals of Public Law 92-500. Addition of land application through rapid percolation will require reservation of percolation sites for City-North Spokane and Spokane Valley subsystems.

Steps. Implementation of Plan A also includes the following steps for accomplishment:

1. Inter-local cooperation agreement between the City and County to provide for planning, management and funding of suggested Plan A.

2. Assumption by Spokane County of implementation of the community sewerage facilities under Plan A for Spokane Valley.

3. Revision of discharge permit for upgraded Spokane STP to provide for evaluation of feasibility of seasonal phosphorous removal through trial operation rather than the currently planned year-round removal.

4. Utilization of the sludge processing and disposal system being provided in the upgraded City STP.

   a. Formulation of plan for data gathering through pilot operation to evaluate criteria for land application of sludge using local soils and crops.

   b. Establishment of program to update the potential for land application as an alternative sludge disposal method as affected by changing technology and costs of fertilizer chemicals.

5. Adoption of a planning policy for phasing out on-site sewage disposal in Spokane Valley leading to implementation of Plan A as applicable to Spokane Valley.

   a. *Constitution of a commission* consisting of regulatory agencies to generate policy with regard to on-site sewage disposal in the Spokane Valley.

   b. Application to EPA under provisions of Public Law 93-523 for classification of the Spokane aquifer as a sole source aquifer.

   c. Implementation of groundwater quality testing program directed toward sampling from the various levels of the saturated zone to evaluate the recharge waters.

   d. Determination of land use planning goals for the Spokane Valley reflecting wastewater disposal needs as indicated by the policy guidelines for the use of on-site disposal.

   e. Implementation of community sewerage through incremental construction initially establishing a "corridor" of sewer service along heavily built up concentrations of commercial, industrial and multiple unit dwellings.

   f. Adoption of a sludge treatment and disposal technology for a Spokane Valley treatment facility. Reconsider as an alternative disposal, conveyance to City STP if feasible at the time.

6. Implementation of Plan A as adjunct to the water quality monitoring systems of all surface water discharges required by law. Supplement with programs such as bioassays.

7. Implementation of an aquifer-wide monitoring of the Spokane Valley aquifer in conformance with Public Law 93-523.

8. Institute a wastewater management planning program for the West Plains communities.

9. Implement management program for septic tank and drainfield operation by mandatory inspection and finding acceptable sites for disposal of septic tank pumpage.

Sewage Solids (Sludge) Disposal. The following conclusions are reached regarding sewage solids (sludge) disposal for the suggested wastewater management plan:

1. For both the City STP and the Spokane Valley elements of the suggested wastewater management plan, Plan S is the most favorable sewage solids disposal plan in terms of costs, social and environmental considerations. Plan S consists of sludge stabilization by anaerobic digestion, sludge dewatering by vacuum filtration and final disposal by truck haul to sanitary landfill.

2. Plan S is consistent with the committed facilities in the expanded and upgraded City STP and is representative of the comparable alternatives in the DOE study (Bovay 1975).

3. If the City completes its planning, solving the truck sewer overflow problem by sewer separation prior to implementation of a Spokane Valley treatment facility, then Plan Y should be considered. Plan Y includes delivery of raw sewage sludge from the Spokane Valley facility to the City STP for processing and disposal utilizing the City sewers for conveyance.

Institutional and Financial Implementation of Wastewater Management Plan. The suggested wastewater management plan includes two physically separate systems:

1. City of Spokane and North Spokane
2. Spokane Valley

The first system will serve an area a great percentage of which is already sewered, while the other serves an area with essentially no present sewerage development. The following institutional arrangements involving cooperative arrangements between the City and County are concluded to be the most advantageous, based on the existing governmental structures and implementation needs.

Institutional arrangements for the subsystem serving the City and North Spokane include:

1. The City would continue to operate its own sewerage facilities, including the treatment plant, the collection system and customer services inside city limits.

2. After adoption of the sewerage general plan, the County, in areas outside the City, would serve as the master sewerage agency, would construct and operate conveyance facilities and would contract with the City for treatment services and for joint operation and construction of certain mutually used conveyance facilities.

3. Local improvement districts (sewerage) would be formed in county areas to construct and maintain collection systems.

4. In the event that an area provided sewerage service by the County is annexed to the City, then the sewerage functions would transfer to the City in accordance with County Services Act, Revised Code of Washington, RCW 36.94.180.

Institutional arrangements for the Spokane Valley subsystem include:

1. The County, after adoption of the sewerage general plan, would serve as the sewerage program management agency.

2. The County would construct and operate the treatment facilities, disposal facilities and trunk sewers.

3. Local improvement districts would be formed to construct and maintain collection systems.

4. In areas where local agencies provide some level of sewerage service, such as the town of Millwood, the County would obtain written approval to manage the regional sewerage program as required by County Services Act, Revised Code of Washington, RCW 36.94.040.

Regarding the financial aspects of the suggested wastewater plan, the study concludes that the "equalization" method of financing the joint City-North Spokane facilities is most equitable.

Urban Runoff. The following conclusions are reached regarding urban runoff. First, conclusions on urban runoff pollution include:

1. City of Spokane service area. The primary unmet need in urban runoff management planning for the metropolitan Spokane area is the serious consequence of overflow by-pass of combined sewers within the City during storm conditions. This will be met through a planned program of sewer separation which has been initiated by the City.

2. <u>North Spokane and Spokane Valley service area</u>. The potential for reducing urban runoff pollution through non-structural measures should be pursued. Design of drainage facilities should consider the benefit of taking all opportunities to include storage and percolation (both a treatment method and disposal technique) so that treatment, if necessary, will be minimized. Source control of pollutants is emphasized over collection and treatment measures.

Second, conclusions regarding urban runoff flow include:

1. <u>City of Spokane service area</u>. Drainage problems within the City exist in some areas due to lack of sewer capacity and, in some cases, deliberate ponding to minimize peak wet weather flows in the combined sewers. South of the Spokane River within the City, the combined sewer problem is compounded by large infiltration flows, some of which originate from deliberate drainage of spring areas. The City sewer separation study program is directed toward solution of these existing internal flooding problems concurrent with resolution of the combined sewer overflow problem.

2. <u>North Spokane service area</u>. Certain locations in North Spokane currently experience flooding due to a combination of runoff from urban development and runoff from presently undeveloped areas which must pass through developed areas. In order to select the optimum storm drainage flow control plan for North Spokane, additional planning and design data and implementation decisions are required, including:

   a. Complete an inventory of existing drainage facilities in the area. There is no complete compilation of existing facilities including County, private developer, Rural Improvement District, State (associated with Highway 395) and City.

   b. Complete a maximum "zero damage" and a maximum "nominal inconvenience" water surface for the major natural drainageways and the associated flow capacity for each.

   c. Complete a detailed inventory of unmet needs for drainage relief throughout the area.

   d. Make physical flow measurements of the existing rainfall runoff relationship for the Five Mile Prairie tributary area.

   e. Make physical measurements of the infiltration capability of the existing gravel pits for use as disposal areas.

f. Establish design criteria for analysis of;

   1) Level of future development to be provided for in Five Mile Prairie and related surface imperviousness.

   2) Level of protection and return period of conditions which cause damage or inconvenience.

   3) Methodology for runoff calculations and hydrograph volumes.

g. Establish a working relationship between City and County for presentation of alternatives to the County Commissioners and City Council.

h. Prepare an overall integrated drainage plan for the entire area before undertaking any piecemeal solutions.

i. The overall drainage plan should consider minimizing the impact of urban drainage on surface water quality. The location of the terminus of the natural drainageway at Little Spokane River appears to present an opportunity for storage in the flood plain which could be utilized to effect economical treatment for the primary concern of bacteriological contamination.

j. The overall drainage plan should consider non-structural alternatives for minimizing increases in runoff from future development by regulation of such development to utilize on-site retention.

3. Spokane Valley service area. At present, with a few minor exceptions, substantially no urban runoff reaches the Spokane River from the existing urban development. There are no valley flood collection systems, all runoff disposal being to dry wells or surface percolation. In general, these facilities provide adequate drainage. Other than maintenance problems to prevent clogging in dry wells, the major surface drainage problems of Spokane Valley involve development around the periphery of the valley and development involving encroachment on natural sink areas. An effective uniform policy should be developed to provide control of drainage from these areas before they become critical problems. The following plan of action is suggested:

   a. Develop a master drainage plan for the bordering slopes of the entire valley which recognizes present and forecast runoff and provides for its disposal by one or more of the following alternatives;

1) Restriction of development on the historic percolation area for subsurface leaching.

2) Substitution of an alternative percolation area for subsurface leaching.

3) Extension of drainage conduit to the river.

b. Develop a policy for storm drainage of slope areas that recognizes the requirements for capacity in these systems to accommodate forecast runoff.

c. Investigate the legal problems that are inherent in both the structural and non-structural aspects of these policies; such as, the extent to which a downhill developer is obligated to provide excess capacity in his system to accommodate flows due to future development and the extent to which property owners be obligated to reserve certain areas for percolation of runoff flows generated off of their property that may or may not have percolated in that specific site.

Institutional and Financial Consideration for Urban Runoff. The institutional and financial needs for the abatement of flooding problems due to urban drainage are substantially the same as those for flood control. The same conclusion is reached; namely, that the City and County have all of the necessary planning, regulatory and financing powers either of themselves or through formation of local improvement districts. The urban drainage problem in North Spokane has special consideration in that City-County cooperation is required. The cooperative approach here could be similar to that discussed under wastewater management. Spokane Valley problems are unique in the approach required for preservation of natural percolative areas to serve drainage from adjoining impervious slopes. There are legal questions here that require solution before either regulatory or acquisitional solutions can be attempted.

Flood Damage Prevention. With respect to flood damage prevention, the following is concluded:

1. Flooding from major streamflows is not a major problem in the metropolitan Spokane area nor in the rural communities of the study area.

2. The primary suggested actions for all areas include flood proofing of existing structures and prohibition of further development in the flood plain.

3. The mandatory requirements of the National Flood Insurance Program, such as flood proofing and flood plain management, when implemented will fulfill some of the flood damage prevention suggestions resulting from this study.

4. The City and County have all the required powers to fulfill the institutional needs relative to flood control in the metropolitan Spokane area, including planning decisions, enforcing non-structural alternatives and financing for property acquisition or structural alternatives.

Water Supply. With respect to water supply, the following is concluded:

1. The forecast water needs for the year 2020 can be satisfied with existing flows. However, the net effect of increased groundwater use is to reduce the amount available for interchange with the Spokane River and Little Spokane River. These interchanges have an important impact on river quality, and temperature in particular. Other water quality implications also deserve consideration as withdrawals increase. These would grow out of the reduced dilution and flushing which apparently is an important factor in reducing the impact of leachate from on-site disposal in the Spokane Valley.

2. The Spokane Valley aquifer has finite limitations and an overall view considering the needs of both Idaho and Washington should be developed.

3. Due to the availability of a more than adequate natural water supply within the urban planning area, the recycling of water for municipal and agricultural use is economically infeasible. Likewise, transporting recycled water to water-short areas within or adjacent to the study area was determined economically infeasible.

4. The quantities of water used in the Spokane Valley indicate a practice of over-irrigation. This is recognized by agricultural advisers. An educational program to keep water use in phase with need is desirable, not only for Spokane Valley but throughout the urban area.

5. The records of water use, particularly for agricultural, are inadequate. The Washington State Department of Ecology water rights file does not currently provide the tool necessary for control. Improvement in records of actual water use is desirable.

Water Quality Enhancement. The following conclusions are reached regarding water quality enhancement:

1. Spokane River and Long Lake.

   a. Artificial recharge of the Spokane Valley aquifer to increase groundwater interchange with the Spokane River may not lower the river temperature or raise the riverflow significantly. However, there may be long-range usefulness to augment the groundwater supply to meet forecast growth in use. The U.S. Geological Survey modeling study of the hydraulic aspects of the aquifer should consider the theoretical problems of artificial recharge.

   b. The effective exchange rate on Long Lake could be increased by lowering the summer pool and may provide a means for further phosphorous reduction and a lower cost of removal chemicals.

   c. The effects of stratification of Long Lake can be diminished by alteration of the level at which water is drawn off for release from Long Lake Dam. The drawoff from the lower layers, in which nutrients are accumulating and oxygen levels are being depleted by stratification, would improve the trophic condition of the lake but may have undesirable effects downstream.

2. Little Spokane River. An educational and tax incentive approach appears to be the most feasible means to encourage protection of the riverbanks from intensive use. Such protection would aid in artificially reversing degradation of the environment and improving the river as a fishery by providing streamside cover to lower the river temperatures.

3. Hangman Creek. There is little opportunity to control the flash high flows or to sustain summer flows by structural means on Hangman Creek due to the lack of suitable sites for storage.

Concerns of the Public. With respect to the study's public involvement program, the following conclusions are reached:

1. There is public support for cleaning up the environment, but there are diverse opinions about the degree (and associated costs) to which they wish to commit themselves in attaining this goal.

2. There is diverse public opinion about providing wastewater management facilities for the Spokane Valley element of the suggested plan until further water quality monitoring conclusively proves that surface and septic tank contaminates are causing contamination of the groundwater.

3. The public has generally accepted the City of Spokane-North Spokane element of the wastewater treatment plan.

4. The flood control and urban runoff findings in the study have been generally publicly accepted.

Implementation of Study Results. Local interests have initiated action on the following:

1. Implementation of groundwater quality testing programing directed toward sampling from various levels of the saturated zone within the aquifer to evaluate the recharge waters.

2. Constitution of a commission consisting of regulatory agencies to generate policy with regard to on-site sewage disposal in the Spokane Valley.

An advisory committee which includes representatives of Federal, State and local agencies was formed by the Spokane County Health District Board of Health to develop a groundwater quality testing program. The advisory committee consists of representatives of the Washington State Department of Ecology, Washington State Department of Social and Health Services, Spokane County Engineer, City of Spokane, Washington State University, Idaho Panhandle Health District, the Homebuilders Association and the Spokane Regional Planning Conference.

3. Some local environmental groups have indicated a strong interest in applying to the Environmental Protection Agency for classification of the Spokane Aquifer as a sole source aquifer under provisions of Public Law 93-523, Safe Drinking Water Act.

Recommendations

The following is recommended:

1. That the report be made available to all Federal, State and local governmental agencies and the regional clearinghouse, which have an interest in the control and development of water and related land resources including wastewater management systems, in the area affected by the study.

2. That the report be provided to those agencies responsible for planning wastewater systems to help meet the requirements of Section 303e, 208 and 201 of Public Law 92-500.

3. That the report be made available to those agencies responsible for other water resource planning as applicable, such as flood control, urban runoff control and water supply.

4. That this report be transmitted to Congress in partial compliance with the basic study authority.

ATTACHMENT I

FLOOD PROBLEMS AND NEEDS

ATTACHMENT I

FLOOD PROBLEMS AND NEEDS

Introduction

This section provides details on flood problems and flood potential in the study area for the Spokane River, Little Spokane River and Hangman Creek. Flooding has not been a major problem in the metropolitan Spokane area. Flood problem locations are indicated in figure 16, section VIII.

Spokane River. Statistical analysis of streamflow records shows that the magnitude of the 100-year flood on the Spokane River at Spokane is 52,000 cubic feet per second (cfs). There have been several historical floods of record that have approached this magnitude, the most recent being the flow of January 1974, which was 46,100 cfs. The largest flood for which water surface data are available is the flood of December 1933, which was 47,800 cfs. The water surface data from these large floods of record which so closely approached the 100-year flood are the basis for development of the 100-year flood profile used in this study to define the flood areas. The Spokane River is well contained in its channels, with substantial freeboard even at the 100-year flood, throughout the study area except at three locations.

The 1933 flood along the Spokane River inundated about 30 acres in the City, including industrial, commercial and residential property along Upriver Drive, the Trent Street bridge (Riverpoint) area and in the vicinity of Peaceful Valley. Flooding occurred in these same areas during recent highriver flows in January 1974.

Little Spokane River. The 100-year flood flow on the Little Spokane River is calculated by statistical analysis to be 4700 cfs. This is a low peak flow for a tributary area of 665 square miles with no artificial controls. Hangman Creek, with almost the same tributary area, has a 100-year flood flow of 28,000 cfs. The largest flood on the Little Spokane within the relatively short period of record is that of February 1970 at 3170 cfs. Overbank conditions occur at flows substantially below the 100-year flood flow, as for example at a flow of 1680 cfs as observed in December 1973.

The river gradient is relatively flat in its lower reaches, below Chattaroy at approximate RM 22, and has developed a characteristic meandering configuration with a low flow channel. At higher flows, the river goes overbank throughout a large part of this lower reach, as it has always done at frequent intervals, essentially on an annual basis. Flows outside the low flow channel are the result of well attenuated peaks with an absence of extreme peaks. Man's impact on the river channel has not significantly hindered flow (except in the last mile

due to backwater from Long Lake). With the exception of several residences in the Dartford area and in the vicinity of Buckeye, there is little structural flood hazard due to high flow conditions of the Little Spokane River. Access to the sewage treatment lagoons at Fairwood is restricted during high flow, but it is expected that this interim facility will be abandoned with the construction of the permanent North Spokane sewage system.

Hangman Creek. Statistical analysis of Hangman Creek flows established a 100-year peak of 28,000 cfs. This peak flow is of the same order of magnitude as the typical spring flood flow on the Spokane River itself, with almost ten times the tributary area. The January 1974 flood at 18,300 cfs is the second highest peak observed in the period of record, the highest being 20,600 cfs in 1963. Flooding along Hangman Creek caused minor damage to buildings, streets, roads and farmlands in Spokane and Tekoa, Washington, in December 1964.

In contrast to the Little Spokane River, which has low peak flows, and the Spokane River, for which there is ample warning time for high flows, Hangman Creek has extremely high peak flows that can be generated with little advance warning. Most of Hangman Creek is through rural area where there are few improvements which encroach on potentially flooded areas.

Rock Creek. Flooding of Rock Creek, a tributary of Hangman Creek, occurred in 1933 and December 1964 at the town of Rockford, Washington, causing damage to streets, business and residential buildings. The potential flood plain for the 100-year flood flow is approximately 18 acres, all on the east side of the stream. This potential flood area is protected by a levee of marginal height.

Flood Problems and Needs

Spokane River. The three locations along the Spokane River in the metropolitan Spokane area subject to flooding are: Peaceful Valley (RM 73.6), Riverpoint (RM 7515 - 76.2), and Upriver Drive (RM 76.8 - 78.0). These are described in the following paragraphs.

The Peaceful Valley area, shown in figure 20, contains approximately 11.7 acres which are subject to flooding and includes 20 single-family residences and one industrial structure. The estimated potential damage with the 100-year flood and failure of temporary sandbag dikes is street, yard and basement flooding involving the 20 homes, with first floor damage to some. The single industrial facility in the area is a casket factory whose concrete floor is above the flood plain, the flood potential being primarily to the storage yard. The residences in the area are single family wood structures, most over 40 years old. The 1974 flood, which was within 0.6 foot of the 100-year flood, caused limited damage as a result of basement and street flooding.

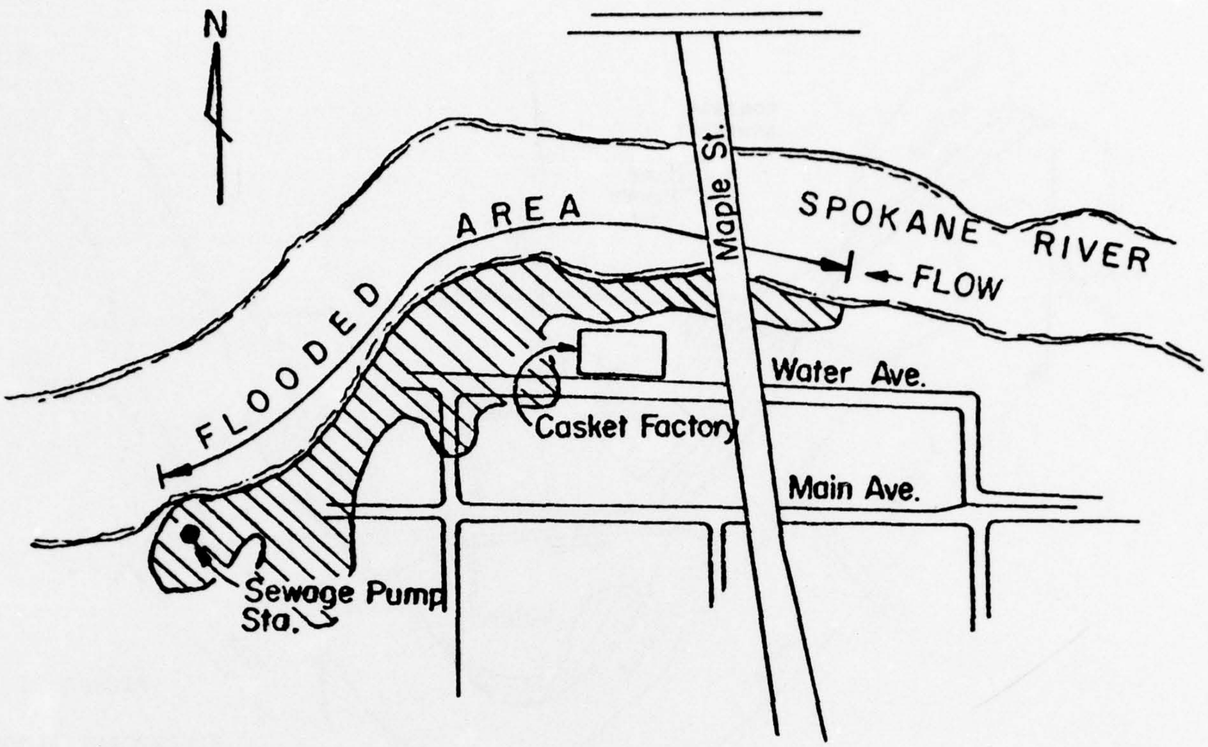


FIGURE 20

PEACEFUL VALLEY FLOOD AREA

Total area affected at Riverpoint, shown in figure 21, is approximately 24.2 acres along the north (right) bank, of which 8.8 acres contained development, all industrial. Maximum depth of flooding is estimated to be 3 feet. This would severely restrict access to the post office and many of the industries located in this area. Most would be able to sustain a flood with little damage other than disruption of operation caused by limited access. Many floor levels are at truck loading dock level. The length of riverbank involved is approximately 1800 feet adjacent to the developed industrial area. The 1974 flood, which was within 1.5 feet of the 100-year flood level in this area, caused only street flooding with limited access to the area.

There is also a limited flooding condition in this area along the south (left) bank of the river. The high water observed on the left bank in January 1974 was limited primarily to undeveloped land. Some limited flooding was experienced adjacent to the river between the Upper Trent Avenue Bridge and Broadway, and at a marina upstream of Division Street; however, no structural damage was reported.

The area affected along Upriver Drive, shown in figure 22, is approximately one mile long on the north bank of the river between the Mission and Greene Street Bridges. In addition to Upriver Drive itself, a house and two apartment buildings are threatened. Possible structural damage was avoided during the 1974 flood because of temporary sandbag and levee construction. The 1974 flood was within 1.5 feet of the 100-year flood stage in this area.

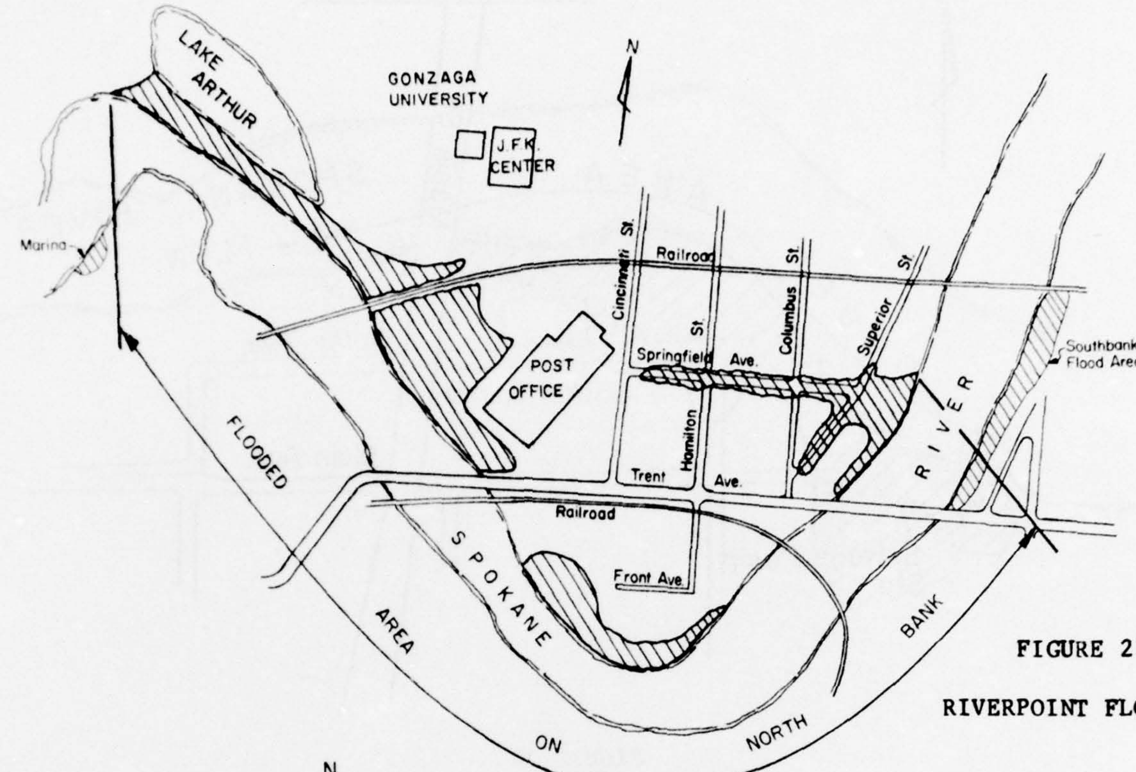


FIGURE 21

RIVERPOINT FLOOD AREA

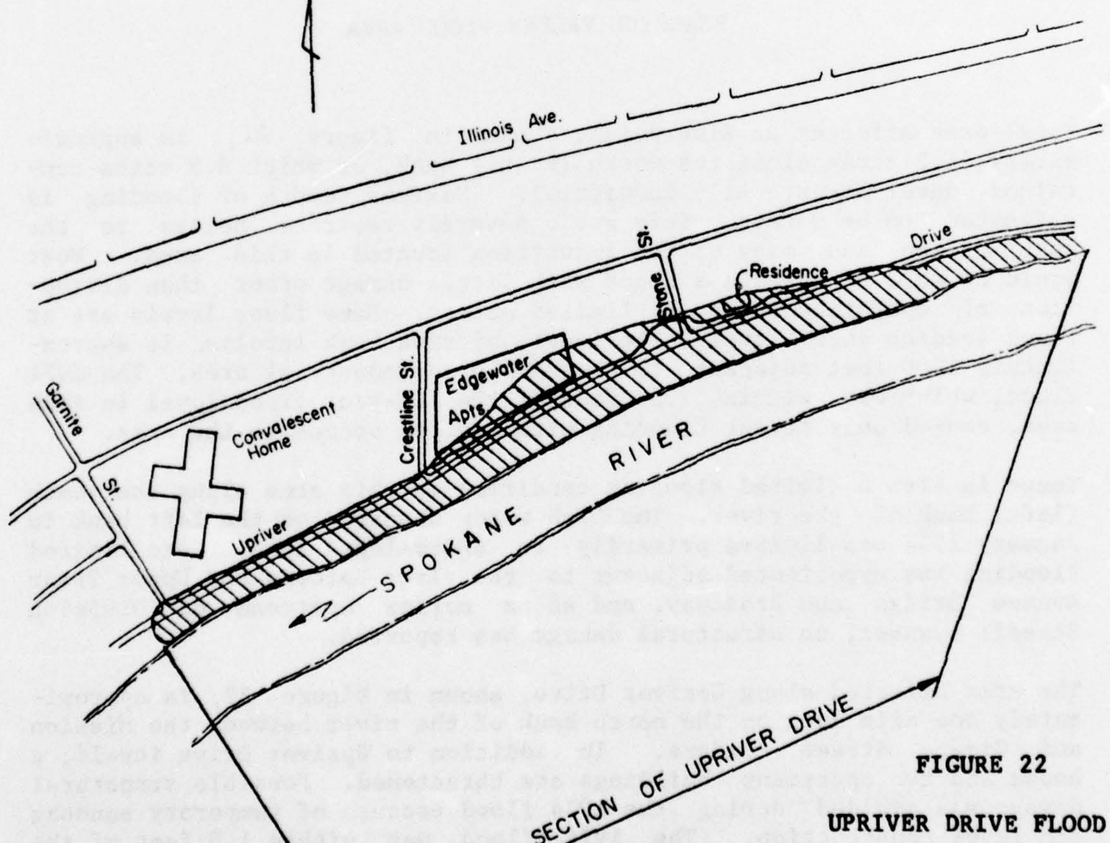


FIGURE 22

UPRIVER DRIVE FLOOD AREA

Little Spokane River. There is little structural flood hazard due to high flow conditions of the Little Spokane River with the exception of several residences in the vicinity of the towns of Dartford and Buckeye. Access to the sewage treatment lagoons at Fairwood is restricted during high flow, but it is expected that this interim facility will be abandoned with construction of the permanent North Spokane sewage system.

Hangman Creek. Most of Hangman Creek is rural area where there are few improvements which encroach on potential flood areas. Flood problems experienced in 1974 are typical of flood damage exposure on Hangman Creek through the urban area. The 1974 problems extended from the vicinity of the 11th Avenue Bridge upstream to a point approximately 1500 feet south of Highway 195 and consisted of locally severe bank erosion, limited inundation of individual residences and failure of poorly constructed levees subjected to high stream velocities. In addition, the Hangman Valley Golf Course suffered extensive damage in 1974 from silt deposition on fairways and destruction of two pedestrian bridges. Roads and agricultural lands sustained some damage in the vicinity of Tekoa. There is also minor damage to residential and commercial property in Tekoa. Bank erosion occurs at various reaches of Hangman Creek throughout the basin.

Rock Creek. Rock Creek, a tributary of Hangman Creek, flooded much of the 18 acre 100-year flood plain in 1933. A locally build levee constructed since that time is insufficient for 100-year flood flows due to backwater potential of the Emma Street Bridge. The 100-year flood plain is occupied by much of the community's commercial and public structures.

Flood Damage Prevention Alternatives

Spokane River. Structural alternatives to prevent flooding of three areas along the Spokane River are limited to levee construction, or in the case of Upriver Drive, raising the road itself. Channel improvements and/or Coeur d'Alene Lake management to control river flows are not cost-effective, feasible alternatives. Multiple purpose impoundments on Coeur d'Alene River upstream from Coeur d'Alene Lake are not under consideration for implementation; therefore, are not considered significant to current flood control problem solving.

At Peaceful Valley, a combination of flood wall and levee estimated at $150,000 exclusive of right-of-way is physically feasible. Cost of the structural alternatives substantially exceed the observed damage potential. Non-structural alternatives include redevelopment of the land to park use capable of sustaining inundation or redevelopment on fill above the flood level, which would probably involve conversion to multiple residential use. Long range local planning regarding the Spokane River front includes redevelopment of the Peaceful Valley area in accordance with the above non-structural alternatives. Other non-structural alternatives at Peaceful Valley are to institute flood proofing measures and to continue reliance on early warning to institute emergency flood protection measures.

A levee project for flood protection along the right river bank at the Riverpoint area was adopted in 1938 but was never constructed. Subsequent investigations disclosed unsatisfactory foundation conditions that made the construction of a levee impractical. Abandonment of the authorized levee project was recommended in House Document No. 531. Previous studies also found to be economically infeasible considered channel improvements in the vicinity of Riverpoint. Current conditions are essentially unchanged and there are no new considerations which would justify re-examination of these conclusions.

Along Upriver Drive the structural alternatives for flood control involving existing buildings subject to flood damage would be to provide flood proofing by permanent structural walls around the few threatened buildings or raising Upriver Drive. Removable sections of flood proofed walls would be required to provide for access. Raising and/or moving the individual house which is in greatest danger onto a new foundation appears feasible and practical.

Little Spokane River. The Washington State Department of Ecology (DOE), under the State's Water Resources Management Program, has recently developed a program for the Little Spokane River in cooperation with a citizen's advisory group. Most of the members of this group also participated in the Citizen's Committee for the Metropolitan Spokane Regional Study. The program, in part, established stream management including water allocation and beneficial uses priorities. The respective DOE and the Corps of Engineers studies have revealed an overwhelming public desire to maintain the Little Spokane River in its current rural agricultural environment.

Structural flood control measures on the Little Spokane River are not feasible. Reservoir impoundments, even if sites were available, would not modify naturally attenuated peaks significantly. Levees and channel straightening would be costly, unaesthetic and would change the character of the area, a result clearly not desired by the local residents and owners of involved property.

Hangman Creek. Hangman Creek at high flood flows causes severe erosion within the flood zone. This river bank degradation is structurally very difficult to control and not economically feasible. Alternatives involving upstream impoundment, and levees and channel improvement in the vicinity of Tekoa are not feasible, due in part to the very limited amount of the total watershed which would be controlled by any one structure.

Upstream alternatives for land management to prevent high runoff and erosion are related to farming practices on the easily eroded Palouse soils which cover a large portion of the Hangman Creek watershed. Adoption of recommended farming practices are not expected to substantially affect peak flows which are often associated with frozen ground conditions. The primary goal of these management techniques is

reduction of erosion and consequent reduction in silt load. These measures are expected to be pursued by the U.S. Soil Conservation Service and farming interests independently of flood control concerns.

Flood peak reduction of the extremely "flashy" flow of Hangman Creek by either construction of impoundments or watershed management is infeasible for alleviation of the minor flood damage problems in the downstream areas. Watershed management for erosion control would have some long term minor flow reduction benefits, but insufficient to significantly impact most flooding problems.

The relatively low flood damage potential, limited number of residential structures and the fact that damage is limited to private property eliminates the justification for publicly funded flood control projects on Hangman Creek.

The only feasible damage reduction technique open to most of these individuals is removal of the existing structures from the threatened areas. In some cases raising the floor level with a new foundation may be satisfactory where inundation is the only threat. Most single family residences cannot be flood proofed except by raising the floor level. Where the threat is from erosion, moving back from the threatened land is the only feasible alternative.

Where bridge abutments, roads and other nonresidential improvements providing public service are threatened by erosion, bank protection is ultimately required either in anticipation of critical flows or on an emergency basis. At present, reliance is being placed on an emergency response. The very flashy flow condition of Hangman Creek and high flow and velocity potential make long-term permanent bank protection to meet the most critical condition very costly.

Rock Creek. There is a need to raise 700 feet of existing levee in Rockford and rebuild the remaining 1000 feet although the economic feasibility is marginal. An emergency dike constructed in 1974 between the Emma Street Bridge and the railroad embankment to the north also requires reconstruction. Other flood damage prevention measures include prohibition of further development within the flood plain and flood proofing of existing structures.

ATTACHMENT II

URBAN RUNOFF POLLUTION ABATEMENT

ATTACHMENT II

URBAN RUNOFF POLLUTION ABATEMENT

Introduction

This section provides additional details on the respective conclusions reached regarding urban runoff pollution abatement.

Urban Runoff Pollution Abatement Conclusions

City of Spokane Service Area. As the City is committed to a detailed plan of study for solution of the combined sewer and associated internal flooding problems, the objectives here are to point out the implications of urban runoff pollution potential that should be considered in these studies. As shown above, the primary abatement needs relative to the urban runoff component of City wastewater flows are:

1. Removal of unsightly floating materials and scums.
2. A small reduction in BOD impact.
3. Disinfection.
4. Reduction in lead content.

The impact from the sanitary component of combined flow, particularly grease which forms floating scum, BOD due to standard soils and high coliform content are judged to be more serious than the urban runoff component and continue to deserve highest priority in the alternatives for dealing with combined sewer problems.

The alternatives mentioned for consideration in the City Plan of Study are evaluated as follows for their respective values in meeting urban runoff pollution abatement needs:

1. Storm relief sewers with satellite treatment facilities, with no storage.

This alternative would treat unregulated combined flow by one of the several methods feasible for highly varying flow and highly intermittant operation. The feasible treatment alternatives are:

1. Screening
2. Flotation
3. Chlorination

This alternative could satisfy the need for removal of unsightly floating materials and for disinfection. It probably could not achieve any reduction in BOD below that which would be obtained in completely separated untreated urban runoff, due to the inclusion of a significant sanitary component. The lack of storage to regulate flow would provide poor control of chlorination and introduce risks to toxicity due to overchlorination or escape of coliforms due to underchlorination and the fact that many coliforms would be carried through with particulate matter. This alternative would provide no opportunity for phosphorous reduction if needed and would do nothing for toxic material control. It is rated as the least satisfactory of the four presented.

2. Storm relief sewers with storage so all potential overflows can be stored for later conveyance to the sewage treatment plant through existing interceptors.

3. Storm relief sewers combined with relief interceptors and further enlargement of the City STP.

These two alternatives would produce the maximum reduction in urban runoff pollution impact by giving it full treatment or at least primary treatment along with sanitary flow. The only defect of this alternative is that it provides a higher degree of treatment than is necessary from a functional standpoint and perhaps more than may be required under regulations for urban runoff when promulgated.

4. Complete storm and sanitary separation with direct untreated discharge of storm waters.

From an overall pollution abatement standpoint, this alternative has high value since it gives the most complete treatment to the sanitary component, which is the more significant load. It does not of course provide any abatement of urban runoff pollution potential but has the advantage of making these flows separately available for the appropriate level of treatment to be added.

It is suggested that where the complete separation alternative is used the terminations be located at places where treatment and/or storage could be added and also where the overflow from treatment could be pumped into the sanitary collection system for ultimate disposal.

5. A fifth alternative that should be considered is the addition of storage to alternative 1. This would remove most of the disadvantages of 1 and raise it to a high degree of acceptability.

From a functional urban runoff pollution abatement standpoint, alternative 5 and alternative 4 with storage and treatment added would be leading candidates. The ideal treatment would result in effective removal of floating materials and scums, a moderate reduction in BOD and sufficient flow regulation and removal of particulate matter to make chlorination a well controlled process.

Where large volumes of storage are not feasible, even token storage to catch the first flush for selected treatment or later diversion to the sanitary system would be very beneficial.

Non-structural measures should not be neglected. Of prime importance where combined sewers are retained is the possibility of keeping the sewers cleaned during dry weather so that the impact of a storm is not heightened by the flush of accumulated materials. Likewise, consideration should be given to the potential for urban load reduction through street sweeping and other housekeeping control measures.

One of the most critical design needs for the City study is a means of sizing storage in full recognition of statistical requirements. It is suggested that a computerized statistical analysis be implemented for this purpose.

North Spokane Service Area. North Spokane has started on a separated system of storm and sanitary sewers. It is suggested that all future construction follow this criterion so that the appropriate level of treatment can be applied in a most cost-effective manner to each component.

The most effective adjunct to urban runoff pollution control where space is available is storage. The natural point for such a storage facility or facilities is in the lowlands bordering on the Little Spokane River. Use of a portion of these lands for temporary storage and/or percolation of urban runoff would be compatible with land use planning.

Adequate storage and particularly storage with percolation would provide the following benefits:

1. Protect the lower Little Spokane River from dissolved oxygen sag due to BOD from urban runoff.

2. Protect the recreational use of the Little Spokane River from coliform discharges from urban runoff.

3. Remove the phosphorous potential by percolation to further reduce Long Lake enrichment.

4. Reduce any possible impact of ammonia through attenuation by time.

5. Reduce lead escape through percolation and/or spreading impact over longer time.

Adequate storage would probably preclude the need for any further treatment other than provision for surface skimming and possibly chlorination. If the storage can be made large enough and percolation adequate, it is possible that the ponds could be operated on a non-overflow basis.

Flow control alternatives are summarized on subsequent pages for the North Spokane storm drainage plan which include supplemental storage. This in-system storage can also contribute toward water quality improvement. These flow control plans indicate a number of possible storage and infiltration/percolation sites including Cedar Road-Francis Avenue and the existing low area immediately north of Whitworth College. The Whitworth sites would require construction of diversion piping which would divert all or a portion of storm drainage flow through an essentially natural storage/sink area.

Spokane Valley Service Area. The major alternative consideration for the Spokane Valley service is whether to continue local disposal to percolation, taking advantage of removals provided by the soil, or to construct a collection system to either surface water or limited locations for percolation.

It is suggested that urban drainage continue to be disposed of to the largest possible extent by percolation to groundwater in small increments as near to the place of origin as possible. This would protect the Spokane River from BOD, coliform and phosphorous impacts. The soil depth to groundwater is expected to protect the groundwater from BOD, coliform and phosphorous impacts. The only groundwater quality concern not directly addressed by the method is possible mineral or organic toxics. As the extent to which these items are removed by the soil is uncertain, it is suggested that vigilance against these items be maintained by non-structural methods including monitoring and control of the use of these materials in the community and industry. At present, the only mineral toxicant of concern is lead from motor fuels and its identification is from literature sources only. Available data for the groundwater of the study does not indicate any percolation impact of lead.

ATTACHMENT III

WATER SUPPLY - WATER USE

ATTACHMENT III

WATER SUPPLY - WATER USE

Introduction

The purpose of this section is to provide additional information on water use and recycle potential to provide basic study suggestions regarding water supply.

Domestic Water Use and Sources

The study area-wide average rate of water use is 279 gallons per capita per day. For the City service area, which has the highest proportion for domestic use as opposed to landscape irrigation use, the proportions are 63 percent domestic and 37 percent irrigation. The use in the urban area ranges from about 80 to 800 gallons per capita per day.

The entire domestic water supply of the urban and suburban areas of Spokane is derived from the Spokane Valley aquifer except for the communities west of the City which are located on Columbia plateau formations. The basalt aquifer of the Columbia plateau has proven to be an inadequate source even for the relatively small communities located on its surface. Fairchild AFB, located on the Columbia plateau, is the only exception, having gone to the Spokane Valley aquifer to augment its local supply. Domestic Water Use Summary, table III-1, provides average daily water use, population and number of services by system categories and expands the use data to include peak day demand, maximum 7-day demand, total annual use and average annual per capita use.

Current Planning for Domestic Supply.

The City has a planning program to match requirements for projected city growth. These plans are limited to the areas within the city limits and do not involve new supplies, so will not have significant impact on this study.

Outside the City the most significant planning effort for water supply is related to the area west of the City, cited above, as having an inadequate supply. The planning effort includes a study done for Spokane County covering the communities of Airways Heights, Medical Lake, Fairchild AFB, Four Lakes, Cheney, Four Corner and Spokane International Airport, plus the adjoining rural areas. Alternative supplies all rely on importation of Spokane Valley aquifer water, the primary variations being whether it would be supplied through arrangement with the existing City system or by an independent system. A plan with a 1975 project cost of $8,800,000 was suggested to supply 18 mgd by 1975, increasing to 27 mgd by 2000.

TABLE III-1

DOMESTIC WATER USE SUMMARY

Agency Type	Population	No. of Services	Avg. Daily Demand/mgd	Peak Day Demand/mgd	Max 7-Day Demand/mg	Total Annual Demand/mg	Average Per Capita Demand/gpcd	No. of Wells
Municipal	191,789	59,201	53.43	150.00	858.60	19,501	279	42
Irrigation Districts	35,942	10,262	20.31	52.79	309.60	7,412	565	63
Water Districts	14,168	4,082	1.71	13.28	76.14	624	121	18
Private Companies	31,846	9,213	6.27	36.69	209.90	2,289	197	43
Assn's-Coops	517	172	0.20	0.39	2.28	73	387	9
Developments[1]	1,745	577	0.23	0.54	3.09	84	132	25
Residential Totals[2]	276,007	83,507	82.15	253.70	1,460.00	29,983	298	200
Federal[3]	15,147	2,057	2.02	7.30	41.80	737	133	6
State[3]	10,540	35	1.58	2.25	12.89	577	150	4
Spokane Int. Airport	2,250	26	0.46	0.65	3.50	168	204	2
Other[4]	5,900	-	0.16	0.45	2.38	58	27	52
Total	309,844	85,625	86.37	264.30	1,520.00	31,523	279	264

[1]Includes Mobile Homes.
[2]Considers only the first six Agency Types.
[3]Does not include Campgrounds.
[4]Includes Motels, Trailer Parks, Schools, Resorts and Campgrounds.

Industrial Water Use

All of the major industries in the study area are located in or near the City. The water supplies for these industries are derived from two principal sources, the domestic water system of the area in which they are located or a private system belonging to the industry, or to a combination of both.

There are thirty-nine major industries with significant water use. Three industries use more than 3.3 million gallons per day each, namely Inland Empire Paper and two Kaiser plants. These three plants account for approximately 66 percent of the total industrial use excluding the Kaiser Trentwood cooling water supply. The characteristics which make the Kaiser Trentwood cooling system unique are: (1) it is drawn from the Spokane River whereas all other industrial supplies are taken from groundwater and (2) it is returned after use directly to the Spokane River immediately downstream from its point of withdrawal. The volume of this cooling water flow is 17.7 million gallons per day or about 80 percent of all other industrial use combined.

The total daily industrial water use is 22.2 million gallons or 8,016 million gallons per year. This is equal to approximately 25 percent of the total domestic water use of the study area. Of this total, 9.5 million gallons or 43 percent are from municipal systems and 12.7

million gallons or 57 percent are from private industrial sources. All of the supply, both municipal and private industrial, is from groundwater drawn from the primary Spokane Valley aquifer.

Recycle and Recycle Potential

One of the reasons for investigating industrial water use in detail is to determine its potential relationship to wastewater management through recycle. Twenty-nine of the largest industries were canvassed to determine recycle activity and potential. The objectives addressed are as follows:

1. Determine to what extent water is presently being used more than once either by using the untreated waste from one process recirculated through the same or another process or using treated waste from one process recirculated through the same or another process.

2. Determine to what extent wastewaters are being produced that are substantially of a quality that could be reused with little or no treatment or with a simple type of treatment.

3. Determine what processes could use water of less than optimum quality that might be available as an untreated or economically treated waste.

The conclusions reached from this survey are as follows:

1. At present, industrial recycling is negligible in quantity except for the Inland Empire Paper Company recirculation of process water which is motivated by product recovery. In general, water is so available and inexpensive that there is little, if any, economic incentive for recycling.

2. There is a significant use of water for cooling which produces a waste that is substantially unmodified chemically and pollutionally except for temperature increase. These waters should not be regarded without qualification to be free of pollution since there is always pollution potential from leaks in the heat exchanger equipment. Hence, its consideration for reuse should be qualified by that limitation.

3. There are waste flows other than cooling water with quality characteristics that have potential for reuse but the total quantity is insignificant on a study area-wide basis. The potential of these other flows is substantially limited to "in-house" recycling. The total of these flows is less than 1.5 mgd.

4. The industrial uses which could use reclaimed water in significant quantities are limited to three industries with an aggregate demand of 1.5 mgd. Cooling water is not listed for potential reuse in this sense.

The future prospects for recycle opportunities for reclaimed wastewaters are no more hopeful than the present conditions since the forecast pattern of growth is away from heavy primary industry toward service industries with little water use or toward food processing which requires waters of the very highest quality.

At present most industrial wastewaters are disposed of by either the City sewage collection system or to a private disposal system. Once mixed with sanitary sewage the recovery and recycle problem becomes part of the larger problem for the area's sanitary sewage. The loss in potential reuse is significant only for unpolluted cooling waters.

Agricultural Irrigation

An estimation of irrigated agricultural acreage and water use is based on evaluation of the following documents:

1. U.S. Department of Commerce Bureau of the Census: 1969 Census of Agriculture.

2. U.S. Department of Agriculture, Soil Conservation Service. Washington Soil and Water Conservation Needs Inventory, 1970.

3. Department of Ecology: Water Rights Files.

4. Records of Irrigation Districts supplemented by interviews with District Management.

The primary conclusion from evaluation of these sources is that there is an unmet need for a reliable method of determining the quantity of water being used for agricultural irrigation in the study area. None of the sources or combinations of sources provide sufficient reliable data to remove the conclusions reached from the qualification of "estimate."

The study area total annual use for agricultural irrigation is estimated at approximately 36,000 acre feet. For Spokane County alone, the estimate is 30,000 acre feet, which is 23 percent higher than that given in the 1969 Census of Agriculture.

The irrigation season extends from April through October, but the significant quantities are used from May through September. The peak month is July for which the average use is 27 percent of the annual use. The peak month withdrawal rate from Water Resource Inventory Area 57, served by groundwater from the primary aquifer, is equivalent to 98 cfs.

Non-Agricultural Irrigation

Non-agricultural irrigation as referred to herein includes irrigation of parks, golf courses and highway landscaping. Landscape, home gardening and pasture irrigation by individual home owners is not included, having been included as a component of domestic water use.

Non-agricultural irrigation is supplied from two sources in the study area; from regular water systems and from separate wells specifically for this purpose. There are cases where both sources apply to a given location.

ATTACHMENT IV

ISSUES AND RESPONSES

ATTACHMENT IV

ISSUES AND RESPONSES

This section summarizes the major issues regarding the study results and suggestions which were raised at or following the public meeting orally or in writing and incorporated into the public meeting record. Similar issues are combined into one statement where applicable. Issues brought to the Corps attention through other correspondence are also covered. Each issue is provided a response.

1. ISSUE - Population projections used by the study for the northwest area of the City of Spokane appeared to be low as expressed by a developer and providing sewage facilities for the area is a concern.

RESPONSE - The population projections are based on those furnished by the Spokane Regional Planning Conference. The study projected a capacity for wastewater facilities that relate to a total demand that would be accommodated by a regional wastewater management plan.

2. ISSUE - Why doesn't the study treat sewage as a resource rather than a problem and consider treated wastes for fertilizer?

RESPONSE - The study considered land application of treated wastes alternatives and could not justify it as an alternative to meet the 1983 standards under Public Law 92-500. However, the plan to meet 1985 goals does provide for addition of land disposal by rapid infiltration for the City-North Spokane and Spokane Valley Subsystems. The study included an evaluation of the various alternatives including land application of the treated wastes not only for cost-effectiveness, but for social and environmental factors as well.

3. ISSUE - Plan D provides for a percolation discharge site in Stevens County to meet the 1985 standards; is Stevens County aware of this and accepting this site?

RESPONSE - Stevens County is represented on the Spokane River Basin Coordinating (technical advisory) Committee which was involved in the alternative selection process. The site is at an unoccupied river bench 12.6 miles downstream from the present Spokane sewage treatment plant.

4. ISSUE - The projected capacity of the existing Spokane sewage treatment plant and its ability to accommodate additional sewage load under the studies suggested plan is questionable on the basis of the City's present plans.

RESPONSE - The study suggestions for wastewater management utilizing the upgraded Spokane sewage treatment plant is based on information provided by the City and its engineering consultant. The City was represented on the Spokane River Basin (technical advisory) Committee which was involved in the alternative selection process.

5. ISSUE - Previous studies of potential contamination of the Spokane Valley aquifer were made by Dr. James Crosby and associates, Washington Water Research Center of Washington State University. The Corps study should have considered these previous studies.

RESPONSE - The Corps study not only considered Dr. Crosby's studies, but reviewed them in detail. Some of the fundamental information developed by Dr. Crosby was used by Dr. David K. Todd in his evaluation in the Corps study. The respective studies are not in conflict in so far as they both recognize that prudent management of the aquifer requires that consideration be given to sewage treatment facilities as the population density increases. Further, a thorough review was made of known well water quality data. The Corps study conducted a supplemental ground water quality sampling program to fill some of the data gaps.

6. ISSUE - Spokane is just now in the process of getting the City's existing sewage treatment plant upgraded to eliminate surface water pollution and the study is proposing another treatment plant for the Spokane Valley along the river and disposal of effluent into the river, further polluting it.

RESPONSE - At the present time there is a very substantial nutrient loading going into the Spokane River from the City of Spokane through its treatment facilities which are, at this time, only primary facilities removing approximately 30 percent of the organic load and a smaller percentage of the nitrate and phosphate nutrients. Under the present development plans of the City to upgrade the City plant to secondary treatment, plus phosphate removal, organics will be removed to the level of 96 percent. The total loading resulting from the Spokane Valley and City upgraded treatment plant is still less than the primary loading from the existing treatment plant. This is compatible with the study's Plan A in satisfying the 1983 requirements of Public Law 92-500. Plan A provides for:

a. wastewater treatment at the upgraded existing Spokane treatment plant for the City of Spokane and North Spokane

b. separate treatment facility near Felts Field, at an appropriate time in the future, to sewer Spokane Valley

c. operation of both facilities with effluent disposal to surface waters.

Plan D removes discharges from surface waters and provides for the addition of land disposal by rapid infiltration to meet 1985 interpreted goals of Public Law 92-500. The infiltration sites are located on a bench along the Spokane River and in the vicinity of Mead, for the City STP and the Felts Field plant respectively.

7. ISSUE - Recommendations to dump sewage in the vicinity of Mead, Stevens County and in the lake do not address the views of residents who live in the area proposed for the disposal.

RESPONSE - This issue also relates to Issues 3 and 6 above. Disposal of raw sewage in the vicinity of Mead and along the Spokane River is not proposed by the study, but effluent from treatment plants would be disposed for further filtration by soils before returning to the river through the soils. Exact location of these disposal sites would be determined by detailed studies during follow on studies by local interests.

8. ISSUE - Social and economic needs of the communities were discussed in the report, but apparently ignored in the final decision process.

RESPONSE - Not only were social and economic needs considered in the evaluation screening of all wastewater management alternatives, but environmental and cost-effective factors were also included in all phases of the study.

9. ISSUE - Were alternative sewage disposal systems considered in the study besides sewage treatment facilities?

RESPONSE - Yes. The study also considered individual and small group sewage disposal systems. Conclusions reached were based heavily on work recently completed for the State of Oregon (Brown and Caldwell, 1975) wherein the study concluded that there is not now, nor does there appear to be any prospect for, a "package" treatment facility that will realistically eliminate the need to dispose of wastewater from a conventional residence by percolation or that will remove all concern for the quality of that effluent.

For urbanizing areas where the residences are served by running water there is only one acceptable alternative to the septic tank and drainfield, namely mechanical oxidation and drainfield. This alternative is presently used in Spokane Valley for multiple units and other larger dischargers. The treatment provided by these mechanical systems, when well operated, is superior to septic tanks in BOD and suspended solids removal, but there is no difference in the quality of effluent with respect to health risk parameters.

10. ISSUE - Why weren't specific wastewater management plans proposed for the West Plains area?

RESPONSE - As the West Plains communities lie outside the metropolitan Spokane area it was not within the scope of this study to develop detailed wastewater management plans for these communities. The study does investigate if there are conditions under which combination of the West Plains communities with the metropolitan Spokane urban area plan would be beneficial and, if so, what impact such a combination would have on the urban area plans. Several alternative wastewater management concepts were evaluated including conveyance of raw wastewaters to the City STP. The study suggests that a wastewater management planning program be instituted for the West Plains communities if augmentation of water supply becomes a reality and provides the basis for detailed planning.

11. ISSUE - The constitution of a commission made up of the responsible regulatory agencies concerned with water quality control and public health as suggested by the study would preempt control by local officials and bring Federal intervention into the local problem prematurely.

RESPONSE - The purpose of the commission would be to generate policy with regard to on-site sewage disposal in Spokane Valley as a firm basis for the local government to proceed with necessary planning and implementation. The commission membership would include local, State and Federal representatives and would not preempt local control.

The need for a commission is based on the fact that neither statutory guidelines nor scientific evidence will automatically provide policy regarding the relationship between on-site disposal and the Spokane Valley aquifer. Policy must derive from judgment applied to the available evidence. A uniform policy accepted and supported by all responsible regulatory agencies is essential to community action.

12. ISSUE - Various costs for the suggested wastewater management plans have been quoted. What are these costs and what do they include?

RESPONSE - The total cost of Plan A is $42,000,000. The annual cost is $4,000,000. The total cost of Plan D, which provides the addition of land disposal by rapid infiltration, is $58,000,000. Its annual cost is $5,500,000.

Total costs are computed in terms of present worth value for the total capital costs plus operation and maintenance costs. The capital costs include the treatment facility construction costs, major replacement costs (adjusted for salvage value), land costs and the costs attendant to design, construction, startup and land acquisition. Capital facilities considered by this study are limited to the main trunk sewer line for each of the three major service areas, plus the treatment facilities.

Operation and maintenance (O&M) costs include operating labor, administration, power, chemicals, repairs and on-going training.

13. ISSUE - What are the incremental total costs for elements of Plans A and D?

RESPONSE - The incremental total costs are:

Element	City plus North Spokane	Spokane Valley	Total
Plan A	$26,000,000	$16,000,000	$42,000,000
Plan D	35,200,000	22,800,000	58,000,000

14. ISSUE - The cost of wastewater management facilities for Spokane Valley only was quoted as $66 million. Does this also include internal sewerage facilities?

RESPONSE - This cost includes the total capital expenditure for Spokane Valley sewerage facilities including the treatment plant and internal sewerage facilities projected through the year 2000.

15. ISSUE - In some areas land development may proceed more rapidly than projected. If the land application sites are developed by 1990 when they are needed under Plan D, what will happen to the developments?

RESPONSE - The study suggests reservation of these lands now before development takes place and the costs escalate. If the land application sites are acquired after development has taken place, then the site location and costs will require re-evaluation.

EXHIBITS

89th Congress

1st Session

United States Senate

COMMITTEE ON PUBLIC WORKS

COMMITTEE RESOLUTION

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE,

That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the reports of the Chief of Engineers on the Columbia River and Tributaries, published as House Document Numbered 403, Eighty-seventh Congress, and other pertinent reports, with a view to determining whether improvements for flood control and other purposes along the Spokane River and its tributaries are advisable at this time.

Adopted: ~~October 7, 1965~~

GPO 39-669-b

Pat. McNamara

PAT. McNAMARA Chairman.

(At the request of Senator Len B. Jordan, of Idaho.)

Exhibit 1

COMMITTEE ON PUBLIC WORKS
HOUSE OF REPRESENTATIVES, U.S.
WASHINGTON, D.C.

RESOLUTION

Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on Columbia River and Tributaries published as House Document Numbered 403, Eighty-seventh Congress, Second Session, and other reports, with a view to determining whether improvements for flood control and other purposes along the Spokane River and its tributaries, Washington and Idaho, are advisable at this time.

Adopted MAY 5 1966 Richard J. Sullivan

Attest: ....
Richard J. Sullivan, Chief Counsel

Requested by: Rep. George V. Hansen

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Exhibit 2

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TECHNICAL REPORT

SECTION

Exhibit 3

REPORT APPENDICIES

APPENDIX A - SURFACE WATER

APPENDIX B - GEOLOGY AND GROUNDWATER

APPENDIX C - WATER USE

APPENDIX D - WASTEWATER GENERATION AND TREATMENT

APPENDIX E - ENVIRONMENT AND RECREATION

Exhibit 4

APPENDIX F - DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

Section

APPENDIX G - PLANNING CRITERIA

Section

APPENDIS H (VOL. 1) - PLAN FORMULATION AND EVALUATION

Section

APPENDIX H (VOL. 2) - PLAN FORMULATION AND EVALUATION

Section

APPENDIX I - INSTITUTIONAL ANALYSIS

Section

APPENDIX J - WATER QUALITY SIMULATION MODEL

Section